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MODERN METHODS

OF

ILLUSTRATING BOOKS

BY

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LONDON

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PREFACE.

THE *progress which has recently been made in the different arts by which books can be illustrated does not appear to be very generally or widely known. My object in writing this little treatise has been to place such information on the subject as I could get together at the disposal of all those who are interested in the production of books, a large and ever-increasing public.*

I have endeavoured to avoid giving technical details, except such as were necessary to make description intelligible. With a view of helping those who require fuller or more special information than the plan of the book permits, I have added in an Appendix a list of a few works—

not a bibliography, or an attempt at one —where the best information I know of can be obtained.

I have tried to indicate with what clearness I could the resources which are available for book illustration, and to show which of the various processes at the disposal of an author it is best for him to employ for any particular purpose.

In describing so many and such varied processes, I can hardly hope to have escaped falling into some errors, especially as information is not always available. Very many processes, and especially the most recent, are worked in secret, and there are thus two difficulties in the way of full description: first, that the information is sometimes not accessible; and, secondly, that when it is accessible, it often cannot be published without unfair interference with private rights or trade privileges. Still, I believe most of the information contained in the following pages is ac-

curate, and I shall always be obliged to anybody who will point out mistakes.

The work would never have been done if I had not received a great deal of help from many friends. Several firms, who make a business of producing printing blocks, have most kindly thrown their workshops open to me; others, again, have supplied me with valuable information, under limitations as to its use. I cannot thank all my helpers by name, but there are two friends whom I must specially mention, Mr. Thomas Bolas, *whose kind advice and suggestions have never been wanting whenever I asked his opinion, and indeed without whose assistance the book would probably never have been written at all; and Mr.* William Simpson, *the well-known artist of the "Illustrated London News," who placed the experience gained by early training as a lithographic draughtsman unreservedly at my disposal.*

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MODERN METHODS
OF
ILLUSTRATING BOOKS.

CHAPTER I.

The Older Processes of Book Illustration.

BEFORE attempting to describe the modern processes of book illustration, it may be well, for the sake of those not conversant with the subject, to say a few words about the older methods. The older processes by which illustrations for books were, and are, produced, may for our present purposes be considered under three heads: 1st, Engravings, printed from an intaglio plate; 2nd, Woodcuts, printed from

the surface of a relief block; 3rd, Lithographs, printed from a stone or other smooth surface.

As the modern reproductive processes, as they are termed, are one and all methods of producing, by cheaper or more rapid means, printing surfaces similar to those produced in the older systems by the manual labour of the artist, it will be necessary, for a complete, if but a summary, treatment of the subject, to state at all events the main principles of these three systems of printing. Those readers to whom the processes are familiar must forgive the employment of a few pages in such a fashion. Those who desire further information must refer to special works on the subject. The titles of some of them will be found in an Appendix.[1]

Engravings are printed from a smooth plate, generally of copper or steel, on which the design has been incised in fine lines or stipple. The plate, after being inked, is carefully wiped, so that the ink remains

[1] See Appendix ii.

only in the lines, and is removed from the surface, which is left perfectly clean. When the paper is forced down upon the plate by the action of the press, it takes up the ink from the lines of the design, the plain portions of the plate which are not charged with ink not leaving any marks upon the paper, and consequently forming the whites of the finished picture. The design is produced in various ways. The artist may (in copper-plate engraving) incise the lines with a graver, or he may (in etching) merely trace them on the plate, and afterwards cause them to be eaten into the surface by the action of an acid; or he may (in the mezzotint process) employ a plate the whole surface of which has been roughened, so that it will hold ink and consequently print black, and on this plate he may scrape out smooth patches which will retain no ink, and will therefore print white. Also he may employ two, or all three, of these methods combined.

In etching, the smooth prepared plate is covered with a thin film of material

capable of protecting it from the action of the acid, and also of such a nature as easily to allow lines to be traced through it upon the surface of the plate. On the completion of the design the plate is placed in a bath of acid, and those parts of the plate which are protected by the "etching ground" are not acted upon by the acid, while the metal exposed by the removal of the ground is etched by it, and the lines originally traced on its surface are "bitten" in. By careful manipulation, covering certain portions of the design with varnish, where the process has gone sufficiently far, and returning the plate to the bath so that other portions may receive longer treatment and consequently be more deeply bitten, the required effects are produced, and deeper or shallower lines formed, as may be required. An account, however, of the precise method by which the etcher produces his delightful results would be foreign to our present purpose. The above brief description must therefore suffice.

The earliest engravings were on copper.

Then steel came into use. The invention of *acierage*, the deposition by electro-plating of a film of steel on the copper, gave at once the benefit of both metals. Engravings are now always made on copper, which being softer is much easier to work, and the finished plate is steeled, so that a hard surface is given to it. When the plate shows signs of wear, the process of *acierage* is repeated.

In printing from wood blocks, exactly the converse action takes place from that of plate-printing. It is the ink from the surface of the block which is transferred to the paper and forms the print, the incised parts or hollows being made sufficiently deep to prevent the ink in them, when any ink gets into them, from reaching the paper. Naturally the ink is for the most part delivered by the roller on the surface only of the block. The presses also in which the two processes are carried on are of a different character. The plate is passed under a roller, and the rolling pressure helps to force the paper down into the lines of the engraving,

while the block is printed in a type press, and receives a steady uniform pressure. It is therefore not so difficult to understand why in one case the ink is transferred from the incised lines of the drawing, while in the other the surface only is the printing medium, the hollows of the block being inoperative.

In practice the wood blocks themselves are not generally used, an electrotype serving in place of the original wood, which is kept merely as a model from which other electrotypes—as many as are required —can be produced. Except in the case of illustrations set up in pages of type, when a cast of the whole page is taken, the cheaper but coarser process of stereotyping is not often used for the reproduction of woodcuts for book illustration. The great advantage of surface blocks, whether produced by wood-engraving or by one of the processes to be hereafter described, is of course that they are printed by one and the self-same process as the book itself. When a picture is wanted to

illustrate the text, in nine cases out of ten it is a surface block that does the work.

The third process, lithography, might almost claim a place among modern methods, had our line been drawn but a few years further back. It differs entirely from either of the processes above described. It may be said to rely for its success on the mutual antipathy of grease and water. A wet stone will not hold greasy matter, and a greasy stone will not hold water. If therefore a design be drawn in greasy ink upon a properly smoothed and prepared stone, and the stone, after a very slight "etching" with an acid solution, be then wetted, the inked parts of the stone will not take up water, and the wet parts of the stone will not take up ink. The stone may therefore be rolled upon with a suitable roller charged with ink, and ink will only be transferred to the lines of the design, the wetted parts of the stone remaining clean. The design may then be printed off upon paper by a suitable press. Further, the design, instead of being drawn direct upon the stone,

may be drawn in lithographic ink upon paper suitably prepared, and known as "transfer" paper. This is laid down on the stone, and the two passed through the press. After the application of pressure, the paper can be stripped off, leaving the design upon the stone. It may be mentioned that this is, for those who can draw, by far the cheapest method of producing illustrations, provided the illustrations required are mere outline sketches, diagrams, or the like. The finest work must not be expected from a process of this nature.

The drawing on the stone is done either with ink, applied by a brush or a pen of special construction, or by crayons, which are composed of much the same materials as the ink, but in a solid form. When ink is used the stone is perfectly smooth, but for crayon drawing the stone is "grained," that is to say, it has a "tooth" given to it by grinding with fine sand, so that it may take the chalk. Drawings of an artistic character are generally done in chalk, the pen and the brush being also employed to a

certain extent. In outline drawings, diagrams and work of a similar class, the pen is principally employed, as it is of course for the ordinary run of commercial lithography.

Transfer paper is paper coated with gelatine, starch, gum, or similar material, the use of the coating being to prevent the ink sinking into the paper, so that it may leave it for the stone, when the paper is forced into close contact therewith. For those unaccustomed to its use, transfer paper is by no means easy to work upon, and for this reason many varieties of it have been made, intended to lessen the differences between it and ordinary paper. These, however, are principally intended to enable persons to write letters in their own handwriting, which can be transferred to stone, and printed direct—an application of lithography which does not concern us here.

Whether the drawing be made upon the stone or transferred to it, the after processes are the same. The stone is lightly washed over with an acid solution of gum. This process is known as "etching," but as a

matter of fact there is scarcely any true etching action at all, the real use of the acid being to render the uncovered parts of the stone more repellent of water; the "gumming" also tending in the same direction.

The lithographic press differs from that used either for ordinary surface printing or for plate printing. The stone with the paper on it is drawn under a fixed scraper, the paper being protected by a material of a partly flexible nature, such as leather. In some presses, however, a roller is substituted for the scraper. A great deal of lithography is now done by steam, though the product of the steam press is naturally inferior to that turned out by a skilful hand.

Zincography may be considered as merely another form of lithography, the processes in the two cases being almost identical, except that a smoothed plate of zinc is substituted for the stone. The power possessed by the zinc of thus taking a drawing in fatty ink, either direct or by the transfer process, is of the utmost importance for the manufacture of "process"

blocks, or substitutes for wood blocks, as we shall see when we come to consider that portion of our subject, many of the most useful methods depending entirely upon it.

Chromolithography, or printing in colours by lithography, is effected by a number of successive printings, one for each colour. To enable each colour to be placed in its proper place on its own stone, a "key-stone" is prepared, which gives the outlines of the picture, and shows where each colour comes. From this stone a number of transfers are taken and laid down on each of the colour stones, the transfer being of such a nature that it is easily removed as soon as its object has been attained. The key-stone itself may be printed from or not, according as the design requires. In the printing of maps, one of the most frequent applications of chromolithography to book illustration, the black outline serves for the key-stone, and is printed first, the light tints of colour being printed afterwards, over the black; in other cases the black may be printed last; in others, again, it is omitted altogether.

To insure correct register, various devices are employed, so that the different colours may all come in precisely their proper relative position. Similar marks may be made on all the stones, and the paper accurately laid to them, or pins may be set in corresponding positions on all the stones, so that when pin-holes made for the purpose are placed over them, the paper will fall into its proper place.

It may be worth mention that a slightly larger number of tints than one for each stone may be produced, since varied effects are obtained by printing one colour on the top of another.

Chromolithography is the process usually employed when coloured illustrations are desired for a book, but coloured pictures may also be produced by the much older device of successive printings from wood blocks. When the sketches are simple in character, and thin flat washes of colour are only required, block printing gives excellent and artistic results.

The processes of lithography have been

described in slightly greater detail than was thought necessary for either surface or plate printing, because, firstly, it is probable that they are less generally known, except to those who have special knowledge of such matters; and, secondly, because some familiarity with them is necessary before it is possible to understand the more recent processes for the manufacture of pictures. Many of those processes, whatever may be their ultimate result, a surface block, an intaglio plate, or a lithographic printing surface, at one stage or other call in the aid of lithography or zincography.

All the three methods, copper-plate engraving, wood-engraving, and lithography, have had their turn as the principal means of illustrating books. At the close of the last century and in the early part of this, books were, as was often stated on their title-pages, "embellished with numerous copper-plate engravings." When it was desired to make some permanent pictorial record of passing events, the same means was employed. Going still further back, we

find that the wars of the Grand Monarque, Louis XIV., were illustrated by copper-plates, and from that date till the invention of lithography at the beginning of the century, when any illustration of importance was to be brought out, whether for a book or other purpose, it was the engraver who was called upon to produce it. Wood-engraving, though the two sister arts are of about equal age, was only used for common and cheap applications.

Down even to our own time the copper plate held its own as the principal method of producing book illustrations of the highest class. The oldest among us can still remember the "Annuals" containing engravings from the pictures of Turner, Stanfield, Roberts, Leitch, Prout, and Harding, books which, as an artist-friend of the writer has well observed, will, when in due time they become scarce, be much sought after and will acquire considerable value, from the high character of the art they contain. The "Books of Beauty," too, which were about contemporaneous with the annuals, were

filled with engravings, and engravings also of very high merit, however little may be the interest now attaching to their generally forgotten subjects.

With the advent of lithography, the palmy days of copper-plate engraving (as a means for book-illustration be it understood, no reference is intended to the employment of the art for the production of separate pictures) came to an end. Of course even at the present time engravings are to be found in books, but it is as an occasional portrait only, or as the finest way of reproducing a work of art. They have long ceased to be the principal means at the disposal of an author anxious to add pictures to explain or to adorn his text. Lithography rapidly drove engraving out of the field, first for cheaper work, and afterwards, as the new art improved, even for the better and more highly finished.

This was at first principally due to the speed and the consequent cheapness of the new process. With a copper plate the whole surface has to be dabbed over with

ink, and then the ink has all to be wiped cleanly off again so that it is left in the engraved lines alone. This operation takes time. In lithography the stone has only to be damped, and the ink-roller to be applied. When a large number of prints are required, and time is limited, several transfers can be taken, and all laid down on the stone for simultaneous printing, so that here again is a great saving. In consequence of the advantages possessed by lithography, copper-plate printing for commercial purposes passed almost entirely out of use, so much so that it is even now the practice when a number of copies are required of some design which can best be produced on copper, to take a print from the copper and lay it down on stone as a transfer, when the required number can be rapidly worked off, frequently by steam. When this plan is adopted, the device of laying down several transfers side by side on one large stone is found specially useful.

When artistic lithography began to make progress, its greater cheapness in printing

gave it an immense advantage as a means of illustrating books. It also cost far less to put a drawing on stone than it did to engrave it on copper by the slow and laborious process necessary; yet again, the lithographic artist could make the drawing direct on the stone, whereas for the engraver a finished drawing made by an artist was required in the first instance. Every way there was a considerable economy, and the result was that engravings as illustrations of books all but ceased to appear.

Books of travel were all illustrated for a time by the new art, and books recording events or describing localities of special, often temporary, interest. It was long before the days of illustrated newspapers. When a war took place in India or the Cape, if any of the officers made sketches, and this was generally the case, his brother officers in the campaign, who were naturally anxious to retain some record of the operations in which they had been concerned, would put down their names for copies of the sketches if they should be published,

so that when they were brought home there would be along with them a subscription list all ready which would cover the expense, and prevent any difficulty in finding a publisher. One of the finest of this class of works, which were generally in folio size, is that of the first Afghan war, the sketches for which were made by Dr. Atkinson, and were afterwards beautifully lithographed by Louis Haghe. About the last of them was William Simpson's "Campaign in the East," illustrating the siege of Sebastopol. Now all this is changed, the special artists of the illustrated papers follow each war, and by the time the war is ended it has been reproduced in pictures issued as the events themselves took place.

The position at one time held by lithography is shown by the fact that Lane, the brother of Lane the Arabic scholar, was made a Royal Academician as a lithographer. He was the first, and will certainly be the last, to attain that rank.

As lithography by its speed and cheapness superseded engraving, so in its turn

it had to give way to wood-engraving. The modern school of wood-engravers, the school founded by Bewick, discovered fresh resources in their art and developed those resources to such an extent that it could compete with any of its rivals as regards the beauty of its results, while the manner in which those results were produced far outstripped its rivals in speed. Though the first cost of producing the printing surface is greater with a wood block than with a lithograph, the fact that the former can be printed with the type may be said to eliminate entirely this portion of the cost, and the rapidity and cheapness with which good wood blocks can be produced is very remarkable. The practice of dividing large blocks among several artists assists very much in their rapid production, though it certainly does not do much to improve the artistic quality of the combined effort. This, however, is a practice that is only adopted for newspaper work, and does not affect questions of book illustration.

That the art of wood-cutting too is now

being in its turn supplanted by the various processes dealt with in the following pages is quite certain. It may be a matter of dispute to what extent chemical or "automatic" engraving processes (both names are equally inappropriate and equally convenient) will oust wood-engraving from the place it now holds, whether they will drive it out altogether, or whether they will only take away from it all the cheaper work, leaving the finest still to be accomplished by its aid. That they are interfering to a large extent with it is unquestionable ; that they can produce results it is incapable of is equally certain ; and that in a very few years they will do all that wood-engraving can do and a good deal more, is, to say the least of it, extremely probable.

CHAPTER II.

Illustrations by Direct Photographic Methods.

IN the early days of Photography, it was naturally thought that the simple process by which ordinary photographic "prints" are produced would offer a ready means of illustrating books. Fox Talbot, whose "Pencil of Nature" was illustrated by silver prints, believed that this would be the first of many similar volumes.[1] Events, however, have falsified

[1] The "Pencil of Nature," published in 1844 and 1845, was intended to illustrate by photography places and objects of interest in England and abroad. The aim of its author was really only to show the applicability of the new art to illustrations of this character. In an imperfect copy, originally belonging to Lady Davy, and now in the library of the Photographic Club, the prints are greatly faded, in some cases they have in parts almost disappeared, leaving

this expectation, and though a certain number of books have had photographs pure and simple as illustrations, they have not been numerous, and now that so many better processes have been worked out, their number is not likely to increase.

Photographic prints of the familiar type known to us are produced by exposing prepared paper, under a photographic negative, to the light. This paper is coated with a thin layer of albumen, containing certain salts of silver which are sensitive to light.[1] The light passing through the transparent parts of the negative, blackens the silver compound. Under the dark parts of the negative it is unaltered. To improve the colour of the picture and to render it more permanent it is treated with a gold solution, and, finally, by immersion in a bath of

but dull yellow traces of the picture. The copy in the British Museum is little, if any, better. The book was originally published in four parts, and contains 24 plates.

[1] The paper coated with salted albumen is submitted to a bath of nitrate of silver. Chloride of silver and albuminate of silver are formed in the paper, which also retains a certain amount of the unaltered nitrate.

hyposulphite of soda, the unaltered salts are dissolved away, while the darker parts remain unaffected.

The pictures thus produced are, as every one knows, of great beauty, but they are in many respects unsuitable additions to a book. They are by no means permanent; sometimes they fade very rapidly, and in every case they lose much of their beauty and freshness in a few years. The cause of this fading is uncertain, and some photographs are much more permanent than others, but they can never be trusted. Then, as each picture has to be produced singly, and the separate manipulations repeated in each case, the production of any number is a laborious and troublesome business. Again, they require to be mounted before they can be bound. Last of all, their purple tone and glossy surface do not by any means harmonize with the printed text. On the whole it may certainly be said that under no circumstances whatever are silver prints desirable for book illustration.

Recently processes have been introduced

for producing prints on paper coated with silver salts in combination with gelatine, in place of albumen. The "emulsion" with which such paper is coated is similar to that employed in the gelatine dry plates now universally used for photographic purposes. Naturally, printing on such paper is a process of far greater rapidity than with albumenised paper. Machines have consequently been made for making the exposures, and by their use a number of prints from one and the same negative can be produced on a long strip of paper. When completed (they are treated by a different process to that above described, as the image formed by light is invisible, and requires "development"), the prints are cut from the strip and are ready for use. The necessity for separate production is thus avoided, and this objection consequently done away with. It is also stated that the prints are more permanent. Whether this is so or not time will prove; even if it is a fact, the process is not one to be recommended for the illustration of books.

But silver is not the only metal whose salts are sensitive to light. By a process which need not here be described prints of a bright blue colour can be produced by using certain iron salts. The process is a good deal employed for producing copies of engineers' drawings and the like, but it is doubtful whether it can well be applied for purposes of book illustration. For its own applications, it has the advantage that the copies can be made direct from the original drawing, provided that the original is on moderately thin translucent paper.

There is, however, one process, known as platinotype, in which salts of iron and of platinum are employed, that is admirably suited for pictures which can be bound up amongst the pages of a book. The tone of such pictures is either black or sepia. They appear to be absolutely permanent—the platinum black of which they are formed resists even strong acids,—and they are produced on paper having a dull or rough surface. As a rule they require mounting, but they can also be produced

with a clean and sharp-edged margin, suitable for binding up without mounting. As with a silver print, each proof is produced separately; but for short numbers, and where the illustrations consist of portraits, landscapes, architectural views, or in fine representations of any objects capable of being reproduced by the camera, platinotype has many advantages. Amongst these may be noticed the fact that the prints are well suited for colouring, or for receiving any artistic treatment. It is indeed one of the few direct photographic processes of which this can be said.[1]

The process by which these pictures are produced is a sufficiently simple one. The sensitive paper is charged with a salt of iron and a salt of platinum. When such paper is exposed to light behind a photographic negative in the usual manner, the iron salt

[1] Since this was written a new variety of the gelatino-bromide paper, referred to on p. 24, has been brought out, in which the proportion of gelatine is so small that it does not give any gloss to the surface. Probably this paper also would serve well for painting upon.

is affected, while the platinum salt remains unchanged. On immersion, however, in the developing bath,[1] the iron salt is dissolved out, and as it dissolves it reduces the platinum salt to the metallic state, thereby forming a picture in platinum black.

Up to the present this process has been but little used for book illustration, though a few books have been published containing platinotype pictures; but when its suitability for the purpose comes to be more fully recognized, it will certainly come into use. For large editions it is unsuited.

The direct photographic methods which have up to the present been used for book-illustration are all of them varieties of, or developments of what is known as carbon printing. They one and all depend upon a peculiar property of gelatine. It is pretty generally known that when gelatine or glue is soaked in cold water, it swells; when it is heated in water, it dissolves. When a mixture of gelatine and a salt of chromium, usually the bichromate of potass or

[1] A hot solution of potassium oxalate.

ammonia, is exposed to light, the gelatine loses its solubility. It neither swells in cold water, nor dissolves in hot. It may not at first be easy to see how this property assists in the production of a picture, but a little explanation will perhaps show how it is utilized. If a film of bichromated gelatine is prepared on any suitable surface, such as a glass plate, or a sheet of paper, and part of the film be exposed to light for a sufficient period, the part acted upon by the light becomes insoluble, the rest of the film remaining unaffected. We can then wash away the unaltered parts with hot water, when the insoluble parts will remain on the glass. If the film has been covered by, say a perforated plate, a piece of fretwork, anything in fact which will screen certain definite portions from the light, while leaving the remainder unprotected, the result will be an exact copy of the pattern, whatever it may be. If instead of a screen of the sort suggested, a photographic negative in simple light and shadow (without intermediate shades or "half-tones") be

employed, we shall have a perfect copy of that negative, however elaborate and full of detail the negative may be. If further the gelatine be charged with any suitable pigment such as carbon, the picture will be reproduced in what is practically a thick ink. Thus there is no difficulty in obtaining a print in solid black and white. If a negative be used, the picture will evidently be a positive.

If, however, a negative be used in which there are half-tones, in fact any negative that is not a copy of a line drawing, a map, diagram, etc., a difficulty at once arises. The heavy shadows are all right, they are represented by masses of the insoluble gelatine; the high lights are all right, they have been protected from light by the dark parts of the negative, and the pigmented gelatine has been washed away by our treatment, so that they are represented by the white paper or the surface of the support on which the picture has been mounted: but what of the half-tones? They have been covered by the less dense parts of the

negative, the light has acted to a greater or less extent upon them, that is to say, to a greater or less depth, and they therefore consist of a skin of insoluble material, varying in thickness according to the depth of penetration of the light, and having below it a layer of gelatine as yet untouched by the light and therefore soluble. If this could be washed away, the varying thickness of the insoluble layer would faithfully represent the varying shadows of the negative; but it is protected, and cannot be reached. Again, if it could be washed away, the hardened portion on the top would be deprived of its support and would float off. The action of light through a negative on to a sheet of bichromatised gelatine has been ingeniously compared[1] to that of cold on a sheet of water. "The whole surface of the latter may be frozen over, and the ice be apparently of equal thickness throughout; but where bridges, and banks, and trees have afforded shelter,

[1] E. Edwards, in the Journal of the Society of Arts, vol. xix. p. 480.

the ice is thinner; so that though the upper surface is perfectly level, the lower surface varies with the degree of cold to which it has been exposed."

The original workers at the carbon process endeavoured to get over this difficulty by exposing the film to the light through the glass, that is to say, placing the negative which was to be copied on the side of the glass away from the film; the light thus passed through the negative, then through the glass on which the sensitive film was mounted, and at last reached the sensitive film itself; the light therefore attacked the film on the side where it was attached to the glass, and the parts rendered insoluble were the parts adhering to and supported by the glass. Then when the film came to be developed, the insoluble gelatine was all on the top, and could readily be washed away, the result being that where a moderate amount only of light had acted, by passing through the half-tones of the negative, a thin layer only of the film was left, and an intermediate tint produced. The varying

thicknesses of the gelatine corresponded exactly to the gradations of the light, and the half-tone picture was faithfully reproduced. But this device did not answer in practice, because, if the negative was separated from the sensitive surface by the thickness of the glass, the light would creep round the edges of the shadows, and there would be a certain amount of diffused light which could gain access to the shaded parts of the plate, especially at the edges of the shadows of the negative, and thus a blurred and indistinct picture only could result.

The problem was however solved by transferring the film after exposure from the support on which it was mounted to another, turning it upside down, as it were, so that the underneath layers of gelatine were brought into a position where they could be dealt with. In the usual practice of carbon printing, the "tissue," as it is termed, that is, the layer of bichromatised gelatine supported on paper, after exposure, is soaked, and

while wet laid down on a plate of glass, or metal, or, according to the best and generally adopted method, on a sheet of specially prepared paper; intimate contact is established by pressure, and after a few moments the paper forming the original mount can be stripped off, leaving the film on its new support, ready for development.

The soluble portions can then be entirely washed away, leaving the insoluble parts attached to the support and accurately representing by their graduated depths the lights and shadows of the picture. If the final support on which the film is mounted be of white paper, the highest lights will be represented by bare paper, the deepest shadows by the thickest layer of pigment, and the half-tones by layers of pigment of various densities, through which the white below is more or less visible. In practice it is found that by this means pictures of the utmost delicacy can be produced, as indeed is sufficiently evident to all familiar with the productions known as "autotypes."

A little consideration will show that a

carbon print produced in the way above described is "reversed" right for left. We are in fact looking at the back of the picture, just as if we held a print, or a printed page, up to the light, and looked at the back of it. To get it right again, the picture must be again transferred, unless in the first instance what is known as a reversed negative has been employed, that is to say, a negative in which the picture has been reversed right for left. It may be as well to remind the reader unfamiliar with photographic processes, that this is a very different thing from a positive, in which the lights of the negative are represented by shadow, and *vice versâ*. Reversed negatives are easily produced by devices which it is not necessary to describe. It may be sufficient to say that photographing the image of an object, reflected in a mirror, will give a reversed negative. The thickness of the glass on which the film of the negative is supported renders inapplicable the simple method of turning the negative upside down, printing it, that is to say, with the glass side, instead

of the film side, in contact with the sensitive tissue. If that were done, sharp images would, as above explained, be impossible, from the amount of diffused light that would then gain access to the tissue. Both the above-mentioned devices are employed in practice. When a number of copies are required, a reversed negative is generally made. Where only a few are wanted, the usual practice is to employ the method of double transfer.

Carbon prints are to a certain extent employed for the illustration of books. They are quite permanent, as the carbon of which they are composed is no more liable to change from atmospheric causes than are the constituents of ordinary printer's ink. They are capable of greater variety than silver prints, since any suitable pigments can be used, and they can therefore be produced in many tints. The process is, however, liable to the objection that each print has to be produced by a distinct and separate operation, and the method is therefore only available when the

number of an edition is limited. The prints also require mounting, and have the glossy surface characteristic of processes in which a film or coating of albumen, gelatine, or any similar material is applied to the surface of the paper.

When prints of this character are required in larger number than can be supplied conveniently when each print has to be separately printed under a negative, the Woodburytype process described in the next chapter may be employed. The results are not quite so good as those of the usual carbon process, but they can be produced in much larger quantities, more easily, and consequently more cheaply.

CHAPTER III.

Woodburytype and Stannotype.

THE Woodbury process is not a true printing process, though it might almost be classed as one. By its aid any number of what are really carbon prints can be reproduced mechanically, and it may therefore be considered to occupy a position between the ordinary process of carbon printing, in which each print is produced separately from the negative, and true printing processes, by the use of which copies are produced in ink and paper by means of a printing surface.

The process itself had its origin in the invention of what is known as *nature printing*.

In the 1851 Exhibition,[1] in the Austrian Department, there were shown some excellent pictures of plants, flowers, etc., which were printed in colours from copper plates. These copper plates were made direct from the object itself. If any small flat article, no matter how delicate, be placed in contact with a plate of metal—whether the metal be as soft as lead or as hard as steel—and the plate be passed through a rolling press or submitted to great pressure by other means, the object will be imbedded in the metal, and on its removal will leave an exact print of itself in the metal. The plate can then be used to give copies in a copper-plate press. So far the process would be of very limited application, but Mr. Woodbury extended it, and by his extremely ingenious invention, rendered it available for the reproduction of carbon prints, that is to say, of any

[1] Earlier than this, in 1849, Dr. Branson, of Sheffield, obtained prints from fern-leaves in gutta-percha, and by electrotyping on this, he made plates stated to have been capable of being printed from.

picture capable of being produced by photographic means.

He found that if a gelatine relief, similar to that forming a carbon print, but considerably stouter, be placed upon a block of lead, and the two subjected to very great pressure in a hydraulic press, the film will be forced into the lead, and on stripping it off, a perfect facsimile of the film will be produced, only it is a reversed facsimile, that is to say, the elevations are represented by depressions, and the depressions by elevations. The film is in practice prepared on a sub-stratum of collodion and is exposed through the collodion, so that the parts unacted upon by light are on the outside of the gelatine film, and can therefore be reached in the development. After development, the film is treated with spirit to harden it, and the result is that it suffers little or nothing from the enormous pressure to which it is subjected. A number of impressions or "reverses" can consequently be taken from the same film, fifty or sixty being by no

means an impossible number. The reverse is then employed as a mould, from which casts, similar to the original, can be obtained. That is the rationale of the process.

To produce the picture, a warm solution of pigmented gelatine is poured into the mould, and a sheet of paper placed on the top; a perfectly smooth surface is then laid over the paper, and pressure applied; the superfluous gelatine is thus squeezed out, only that being retained which is held in the hollows of the mould. The paper being forced down upon the highest parts of the mould, all the composition is squeezed out from between the paper and the mould, so that the paper there is left clean, and forms the highest lights of the picture; where the mould is deepest, the thickest layers of gelatine are formed, and we have the darkest shades of the picture; while the varying depths of the relief between the two extremes reproduce with admirable exactness the various gradations of light and shade, precisely as in a carbon print.

It is difficult to believe that so apparently rough a method as this can produce good results; but as a fact it does, for pictures of the utmost delicacy are constantly being made by it. In practice the difficulties of manipulation are considerable, but these difficulties are all capable of being overcome by skill and experience, and the practical results, as everybody can see by looking at any good Woodburytype print, are admirable.

In carrying out the process commercially, each mould is set in a frame with a hinged lid. After the lid has been closely brought down on the picture, it is locked by a catch, so that it is held fast until the gelatine has had time to set. A number of these frames are usually mounted on a revolving table, and the workman fills each mould in turn as it is brought round to him by the table. By the time the frame has completed the circuit, the gelatine is set, and the paper, now bearing the picture securely mounted upon it, can be removed, when the frame is ready for a fresh charge. A Woodburytype print is therefore, as above said, a cast in a

gelatinous pigment of the original film. As the cast shrinks very considerably in drying, it is necessary to exaggerate the depth of the mould, and for this reason to use a film in preparing the reverse very much thicker than would otherwise be needful. For this reason a Woodbury film is much thicker than the film forming an ordinary carbon print.

In order to simplify the process, and to obviate the necessity for the use of a hydraulic press, the inventor made many attempts to obtain a suitable mould, by some method of casting from the relief. None of these, however, have come into practical use, though certain of them are experimentally practicable. After trying many devices, he hit upon the process which he called "Stannotype," from the fact that the printing or moulding surface is coated with tinfoil. In it, the relief itself forms the mould, and therefore it will be understood that this relief must be of the reverse character to the relief used in the original process, that is to say,

the shadows must be the depressions, the lights the elevations. This was effected by exposing the sensitive film under a positive, instead of under a negative. The film is laid down on a sheet of glass, and developed thereon as if it were a carbon print. To render it fit for printing from, it only requires to be coated with tinfoil; this is effected by moistening the face of the relief with india-rubber solution, laying a sheet of tinfoil upon it, and passing the whole between a pair of rubber-covered rollers. The foil adapts itself accurately to the relief, and a mould with a metallic surface is therefore produced by this extremely simple means. The remainder of the Stannotype process is the same as the original Woodbury. The advantages claimed for it are that the relief is much more easily and simply obtained, and without the use of a hydraulic press. It is therefore thought to be applicable for shorter numbers than the Woodbury, and the inventor believed that Stannotype would come into use among portrait photographers for the printing of portraits; but

this expectation does not as yet appear to have been realized.

Woodburytype prints have been largely used for the illustration of books, and where a very short edition is to be issued, no doubt the process might very well be employed in the modified form of Stannotype. Probably its most frequent application has been for the production of portraits, as many of the copies of photographs used to illustrate memoirs with a portrait of their subject, or a book with a portrait of its author, are produced by the Woodburytype process. Some advantages and disadvantages the process has in common with the process of carbon printing previously described, and the results are not quite so good. On the other hand, Woodburytypes can be produced in almost unlimited numbers, though, of course, with less rapidity than in a true printing process in which the agency of steam can be employed. The process is not well suited for the production of large pictures, first, because to make the leaden relief a press of large size and of

very great power is required, and secondly, because of the difficulty of securing absolute parallelism between the surfaces of the mould and the lid of the press, as well as absolute uniformity in the paper. Naturally the difficulties are increased when these surfaces are of large size.

CHAPTER IV.

Collotype and Photolithography.

SPEAKING strictly, none of the processes previously described can be termed printing processes. This name is properly reserved for methods in which surfaces are employed capable of transferring to other surfaces impressions of themselves in ink or colour. We have now to deal with the preparation of such surfaces by photographic means, and here we really reach the important portion of our subject. For the production of illustrations in any number, the printing-press in one form or another must be employed. It is true, as observed in the last chapter, that the Woodburytype process offers valuable facilities for the production

of copies of photographs in comparatively large numbers; but for the illustration of books this will not suffice, and we require a process which will give us prints in ink, capable of being inserted among the pages of a book without incongruity, or obvious unfitness for their position.

Photographic methods can be applied to the production of printing surfaces of each of the classes mentioned in the first chapter—intaglio plates, surface blocks, or lithographic surfaces. In many cases also the methods first devised in connexion with photographic methods have afterwards been found applicable to other processes not of a photographic character. For instance, the process of chemical engraving, originally developed in connexion with photography (though its origin may be traced back to the first efforts of Senefelder, the inventor of lithography), is now constantly applied to the production of printing blocks in which photography has no share whatever, and so with other processes. Still, all or nearly all the modern improvements

have arisen directly or indirectly from photography, and consequently it will be convenient to consider in order the manner in which photography can be applied to the production of the three descriptions of printing surfaces. And, as the natural sequence of the subject seems to involve our taking them in the reverse order to that set down above, we shall commence with processes of a lithographic nature, that is to say, processes depending on the principle on which lithography is based, the mutual repulsion of oil and water on surfaces, not only of stone, but of any suitable material often of a very different nature from stone; we shall then consider methods by which relief blocks for printing in the ordinary type press can be obtained; and after that we shall deal with methods for the production of intaglio plates for printing in presses of the nature of the copper-plate press.

The first-named class will form the subject of the present chapter. Before, however, dealing with the processes themselves, it

may be as well to devote a little more space to the consideration of those remarkable properties of the compounds of a colloid substance, such as gelatine, starch, gum, etc., together with an alkaline chromate, such as the bichromate of potass or ammonia, since upon these properties most of the processes depend. We have already seen that when a layer of this compound is exposed to light under a photographic negative, the parts receiving most light become insoluble in warm water, those receiving no light are of course unaffected, and the intermediate shadows are represented by layers of insoluble gelatine, proportionate in depth to the amount of light they have received. Plain gelatine is, as every cook knows, soluble in hot water, but not in cold. When soaked in cold water, gelatine softens and swells; but to dissolve it requires the application of heat. The amount of heat varies according to the character of the gelatine. Gelatine containing bichromate, which has not been exposed to light, behaves in this respect

exactly like plain gelatine. The result is that if an exposed film (mounted, for convenience sake, on any suitable support such as a plate of glass or metal) be soaked in cold water, the soluble portions will absorb water and consequently swell up, and the bichromate they contain will dissolve out, the insoluble parts not being affected, while if a similar film be soaked in hot water, the soluble parts will be entirely washed away, leaving behind them the insoluble parts. It will be understood that the line dividing solubility from insolubility is not a fixed one, but depends to a certain extent upon the temperature of the water employed. Whichever process be adopted, the film, after this treatment, has practically lost its sensitiveness, and can therefore be safely exposed to light. In one case the sensitizing constituent has been washed out of the parts which could be injured by such exposure, in the other those parts of the film have been entirely removed.

And there is yet another effect produced by wetting an exposed film of bichromatized

gelatine. The surface of the unexposed parts becomes covered with a multitude of tiny crape-like markings or folds. The applications which have been made of this property will have to be considered later on; here it will be sufficient to merely note the fact.[1]

The films which are to be used for the various purposes which have been or will hereafter be described, vary considerably in their nature, according to the particular purpose for which they are intended, as to the relative proportions of the bichromate and the colloid substance, in the nature of the colloid substance itself, and in their thickness and toughness. This last property is generally imparted by the addition of some substance having a hardening or tanning influence, such as alum. The temperature

[1] The cause of this is doubtless the strain that is put upon the gelatine film. The under surface of the film, being attached to the glass or other rigid support, cannot yield, and when the film swells a series of strains is set up which causes minute folds and fissures. Hence the reticulated appearance.

at which the film is dried is another disturbing element, influencing very considerably its behaviour under development. For carbon printing thin films only are required. We have seen that Woodburytype requires much thicker films to allow for the shrinkage of the gelatine which is poured wet into the mould. Collotype, as will be shown, requires a strong tough film.

In the processes described in the last two chapters, carbon-printing and Woodburytype, the picture is formed of gelatine and pigment, the properties of the bichromatized gelatine being employed in the one case to form the picture itself, in the other to form an original picture or type, facsimiles of which are reproduced mechanically. In the next class of processes, these same properties are utilized in a different way, to produce a surface from which copies in ink can be printed direct, or an image which can be transferred to stone or zinc (or produced upon them), so that copies can be printed from the stone or from the zinc. The first

class of processes is termed collotype;[1] the second comprises photolithography and photozincography.

In the collotype process the gelatine film itself forms the printing surface, and may indeed be said to take the place of a lithographic stone.[2]

To prepare a collotypic plate, a warm solution of bichromated gelatine, to which is added also a certain proportion of albumen, and a small quantity of alum or other hardening agent, is poured on a suitable support, generally a thick glass slab, though it may be a piece of slate, or even a lithographic stone. When the film thus formed is dry, it is exposed, through the glass, when glass is used as a support, to light. By this means a layer of insoluble gelatine is formed on the glass. A second coating of the solution is then given to the plate, which is again dried. It is then ready for exposure under a negative in the

[1] German Lichtdruck; French Heliotype or Phototypie.

[2] Hence the derivation of the word, from the Greek κόλλα, *glue*.

ordinary manner, the progress of printing being to a certain degree visible on looking through the back of the plate. As soon as it is thought sufficient exposure has been given, the plate is immersed in cold water and allowed to soak, when the bichromate will be washed out from those portions which will absorb water, while the harder portions repel the water, and are found to be dry when the film on its glass support is lifted from the dish in which it has been soaked. Those parts also which have received less exposure to light, as having been under the half-tones of the negative, will absorb a greater or less amount of water as they have received less or greater exposure; the amount of moisture in the film thus representing the gradations of light and shade. If now a lithographic roller charged with ink be passed over the surface of the gelatine, the dry parts will take up ink, while the moist parts repel it, the parts intermediate between the two extremes taking up more or less ink according to the amount of water they contain.

It will be understood that in a process of this nature a perfectly flat surface is required, and consequently the relief caused by the swelling of the wetted gelatine is a disadvantage. It is therefore usual to keep this down by again exposing the whole of the back of the plate to the light for a short time, before soaking. There is thus produced a layer of insoluble gelatine on the under surface of the film, and there is consequently a lesser thickness of soluble gelatine to swell. The thinner the film can be made, the stronger its adhesion to the glass, and the less likelihood there is of its being torn from the glass in the process of printing. So strong indeed is the hold of the gelatine upon the glass that in some cases the glass has been broken by the adhering film, instead of the film being torn off.

The plate when dry is fixed on the bed of a lithographic or other press, and printed from as if it were a lithographic stone. The press employed may be of the usual form of a lithographic press with a scraper or roller,

under which the stone (or collotype plate) is drawn, but an ordinary printing press giving a direct downward pressure is also employed. The largest printers of collotype in this country, the Autotype Company, use the latter form of press alone.

As an experiment, a collotype plate has been printed from simultaneously with ordinary type, and it is stated[1] that moderate success was achieved. Such a process, however, was merely experimental, and there is no reason to expect that it will ever get beyond this stage. Possibly for rough and hurried work it might indeed be useful, but not for work aspiring even to moderate artistic merit.

The collotype film is of course of a very delicate nature, compared with a stone, and the number of copies which can be printed from it is limited. The number varies very much, and depends not only on the nature of the plate itself, but also on atmospheric conditions. In cold weather more work can be got out of a plate than in hot. As

[1] *Photographic News*, 1884, p. 130.

many as two thousand impressions are said to have been printed from one plate, but this is quite an exceptional number. Roughly speaking, it may be said that it is very good work to get five hundred impressions, and that the plate is likely to give out after two or three hundred. Still, when it is destroyed or worn out, the preparation of a second plate from the original negative is not a matter of any great difficulty or delay. Unfortunately, such a second plate is not likely to be identical with the first, and the prints from it will not be uniform in character with those from the first.

The manipulation of a collotype plate requires greater care and skill than is necessary for satisfactory working from a stone. The film is liable to adhere to the roller and be torn, and for this reason a velvet roller has been introduced to take the place of the usual lithographic roller of leather. The velvet has no tendency to drag the film, and its introduction is said to have considerably increased the number of prints which can be produced from each plate. In this

country, however, it does not seem to have met with much favour, and the principal collotype printers still use rollers of composition or leather.

Of late years steam has been employed to a small extent for collotype printing, and there seems no doubt that in the immediate future its use will be very largely extended. Naturally, it is only for the commoner sort of work that steam can be employed. Still, as collotype is coming into use for advertisements, for illustrated price lists, and similar purposes, work quite sufficiently good for such applications can be done by steam.

Paper of any sort can be employed. At first it was usual to print collotypes on a paper with an enamelled surface, and in ink of a tint like that of silver prints. As a matter of fact, much pleasanter results are produced by printing on paper with an ordinary smooth surface and in black, not purple ink. Great care, however, has to be used as regards the paper employed, as there is a risk of its affecting the delicate surface of the gelatine. It is for this reason

that the enamelled surface is preferred. By methods similar to those employed for chromolithography, collotypic prints may be obtained in more than a single colour. This process is termed Hoeschotype, from its German inventor; though it does not appear to have been as yet worked to any large extent, it is certainly capable of producing excellent results.

Good collotypes show great delicacy, though not equal to the best silver prints. The results are finer than Woodburytypes, and are certainly much better suited for the illustration of books. This is indeed a purpose to which the process has been largely applied, and it is well adapted for the representation of still life, objects of art, and subjects of this character. Its power of rendering half-tone, and consequently of representing delicate gradations of light and shade, is very great, and it is specially suitable for fine work, from the fact that there is no risk of washing away the finest lines, as may happen with certain of the other processes yet to be described.

Collotype lends itself admirably to the reproduction of artistic objects in low relief, such as coins, medals, bas-reliefs, etc. In fact it would be difficult to imagine finer results than it gives in this particular branch of art. The impression of solidity given by a good collotypic print of an ivory carving or a bas-relief is simply marvellous. It is as perfect a representation of the original as can be transferred to paper.

Of course much depends upon the original negative. In photographing medals or metallic objects giving brilliant reflections, the ingenious plan is adopted of making a plaster cast of the medals and photographing it, it being much easier to get a good photograph from the dull white surface of the plaster than from the glittering metal. In photographing larger objects of bright metal, various devices are employed. For instance, the brilliancy of a polished silver cup may be dimmed just before the picture is taken by placing in it a lump of ice. The moisture held in suspension by the atmosphere

deposits on the chilled metal, and we get a dull matt surface instead of a bright one.

Collotype has been applied with much success to the reproduction in facsimile of ancient manuscripts and printed books. When only a small number of a reprint are required, it is convenient; but otherwise it has no advantages above the photolithographic processes soon to be described, and compares unfavourably with them in its results.

For printing the picture on a collotype plate, a "reversed" negative is required. The reason of this is obvious. The original negative we know is reversed, right for left. The picture printed from the negative is reversed again and brought right. If we take this picture and make a printing surface of it, as we do with the collotype plate, we get another reversal, which makes the print wrong. We must therefore start with a reversed negative; a negative, that is, giving a true picture as regards right and left when we look at the face of it, and then the series will end in a correctly printed picture.

For another reason it is often necessary to reproduce the negative. To insure its absolute contact with the flat collotype plate, the negative must be flat. There is no power of accommodation as there is when, in the ordinary practice of silver printing, a negative is placed on a sheet of paper, backed with a pad of yielding material. Of course, if the negative and the sensitive surface are not in absolute contact, we cannot get a sharp print.

The prints are permanent, at least as permanent as printing ink and paper can make them, and they can be in any colour. They require no mounting. They can be produced at a moderately cheap rate, and in tolerably large numbers. For very long numbers there is the objection that, as several plates have to be employed, the prints are not absolutely identical, and in the case of second editions there is the further objection that the plates have to be reproduced afresh, at precisely the same cost as for the first.

It will thus be seen that collotype is

the proper process for moderate editions, especially when a reprint is not contemplated. The cost of producing a large number is not proportionately much less for each example than the cost when a small number only is issued, unless steam printing is used, and this can hardly be recommended for book-work.

In the second class of printing methods above referred to, comprising photolithography and photozincography, photography is employed to produce on the surface of the stone or of the metal an image in some material which repels water and attracts grease, so that it can be inked up with lithographic ink and a print produced in the same way as from a lithographic stone. The working of the process is not very different, whether the printing surface is stone or metal, and therefore it will be sufficient to describe it as applied to stone. It will be understood that for the most part the description is applicable also to printing from zinc.

In some cases the sensitive material is

spread on the surface of the stone itself, and in this position exposed under the negative, but in most cases it is usual to employ a transfer process, and as this is the commonest and most convenient plan, it may as well be first described.

The transfer process as applied to photo-lithography does not differ very much in principle from the ordinary lithographic transfer process, except that the design is produced by photographic means instead of by the hand of the artist. As with lithography plain and simple, so in photolithography, we can only reproduce line-drawings or designs in solid blacks and whites. The half-tones of a negative cannot be reproduced by this method, as they can with collotype.[1] For this reason the process is only applicable for reproduction ; it cannot produce a print from a negative taken direct from nature. What it can do is to reproduce in facsimile any picture or design that has been produced by any printing

[1] The methods employed for reproducing half-tones in stipple will be described later on.

process whatever (in which tints are not employed), type, engraving, woodcut, or lithograph, also any line-drawing in ink, pencil, or chalk, anything in fact which already possesses the grain, line, or stipple required to hold the ink.

Whatever may be the original, it has to be photographed, and it is essential that the negative should be extremely dense, while the lines are represented by clear glass without any deposit upon them. The utmost attainable contrast is in fact necessary, so that as much light as possible may pass through the lights of the negative, and as little as possible through the shadows. Upon the production of a suitable negative much of the success of the whole process depends. Unless good strong contrasts exist in it, it is useless to expect to produce strong blacks and clear whites by its aid. The wet collodion process is generally used for the purpose, as it is more easy to "intensify" the shadows to strong blackness, while leaving the lines clear, than with gelatine plates. These are, however, used

to a large extent by many photolithographers, and doubtless their use will extend.

The transfer paper which is to be exposed to light behind the negative is coated with a thin layer of the sensitive gelatine compound.[1] The exposed film has next to receive a coating of ink, and this may be effected in two ways. In the more usual process ink of a suitable character is dabbed over the whole surface of the paper, or applied thereto by passing the paper, while in contact with an inked stone, through a press. The paper is next soaked in water. The soluble gelatine can then be washed away by means of a sponge or brush, and as it is removed it takes with it the ink on its surface, leaving the ink adhering to those parts only of the film which have been hardened by the action of light.

In the latest modification of the process

[1] For full information as to the preparation of the tissue, and for the amplest details as to the working of the whole process, reference can be made to no better source than the long series of articles contributed by Lieut.-Colonel Waterhouse to the volumes of the Photographic News for 1882-3-4-5.

the paper is soaked to get out the unaltered bichromate. It is then stretched over a sheet of glass, and very carefully inked over with a velvet roller, when the ink, as in the collotype process, takes on the insoluble parts, but leaves the soluble parts untouched and clean. The advantages of this method are that the finer lines are not washed away —since the whole of the gelatine remains— as is sometimes the case with the "washing off" process, and the paper attaches itself more firmly to the stone in the process of transfer.

The transfer is effected in the usual way, by laying the paper on the face of the prepared stone or zinc, covering it with a protecting layer of paper and "glaze-board," and passing the whole through a lithographic press. Adhesion is soon effected, and the paper may then be wetted and stripped off, leaving the print in fatty ink behind it on the stone. Henceforward the proceedings are the same as in lithography. The plate is treated with weak acid, gummed, washed and inked up in the usual manner.

A very important point in the process is that alterations or additions can be made by hand on the stone or zinc. A proof can therefore be submitted and any corrections made which it is in the power of a lithographic draughtsman to effect. The final result may indeed be to almost any extent a combination of hand-work and photography, and this often is extremely convenient. It may sometimes be worth while to make a copy by this process with the intention of introducing considerable alterations. In the case of a map, for instance, though much new material may have to be introduced, and possibly some of the old outlines altered, it will frequently be the case that much of the draughtsman's labour will be saved by making a photolithograph, erasing the parts requiring alteration, and filling them in by drawing or even by a second transfer.

For the reproduction of maps, plans, diagrams, or original sketches, no better plan need be desired. In photographing the original copy, it can be either reduced

or enlarged (in practice generally the former), and in either case the scale is preserved with almost absolute accuracy.[1] It is evidently quite as easy in making the negative to reduce the original to any required size, as it is to reproduce it of the same size, and by a certain amount of reduction, greater delicacy in the resulting print is obtained. If the reduction is carried too far, the lines clog up, or become too fine, and are lost. In copying plans with lettering on them, it is necessary to avoid over-reduction, or the lettering becomes so small as to be illegible. When a transfer process is used, a reversed negative is not required, the necessary reversal being effected by the transference of the image from the paper to the stone.

When large maps or plans are to be produced by the process of photolithography, larger, that is, than can be brought within the compass of a single negative, a number of transfers can be laid down on the same

[1] The unequal stretching of the paper introduces a slight, but very slight, element of inaccuracy.

stone, great care being of course taken that the edges fit together with the utmost accuracy, so that no trace of the join may be visible in the finished print. In the case of large prints zinc is generally preferred, on account of its greater lightness and handiness, as well as its greater cheapness. Stone has the advantage that corrections are more easily made upon it, but even this advantage is of less importance than it used to be, for the difficulties in the way of working upon zinc have now been for the most part overcome.

It has been stated above that the transfer method is not the only one available for the production of photolithographs. The image from the negative can be printed direct upon a sensitive film, spread over the surface of the stone, and this sensitive film may be composed of bichromated gelatine or other substance capable of being affected by light. If gelatine be employed, we get a process partaking of the nature of collotype, and the printing is really from the surface of the gelatine, rather than from the stone. Of

substances other than those of a colloid nature (gelatine, albumen, etc.), the only one requiring mention is bitumen or asphalt. A dried film of this substance is by the action of light rendered insoluble by its usual solvents, and therefore if such a film be exposed under a negative, the picture can be obtained by dissolving off the portions left soluble; turpentine being generally used for the purpose. The hardened parts will take lithographic ink, and the stone with the asphalt image upon it can therefore be treated as before described, and printed from by the usual lithographic processes. This method, however, is not largely used, and therefore calls for no further notice at present. When we come, in a succeeding chapter, to consider the production of phototypic blocks, we shall find more important applications of the asphalt process, and it will be as well therefore to defer till then any further notice of it.

It may be useful to conclude this description of the photolithographic processes by a few suggestions as to the points to which

attention should be devoted in the preparation of drawings which are intended to be reproduced by them. To a great extent the same suggestions will be applicable to any photographic process for the reproduction of lines, since, as we shall see as we proceed, the first steps in all of them are generally identical. The detailed instructions issued by the Indian Survey for the guidance of draughtsmen in the department will be found in an appendix.[1]

It is important to remember that the original will be reproduced in facsimile. As Colonel Waterhouse says,[2] "The camera will not correct and beautify faulty drawing, as the lithographer is often expected to do, though a good deal may be done by skilful touching up." Hence the drawing must be made precisely what the finished print is expected to be. It may be larger, and this is an advantage, since in the reduction the lines and the general character of the work will be fined down. When lettering is

[1] See Appendix i.
[2] *Photographic News*, 1882, p. 482.

inserted in a plan intended for reproduction, it must be remembered that the lettering will be reduced on the same scale as the plan itself. When the plan of copying the drawings of patent specifications by photo-zincography was introduced in 1876 in the English Patent Office, this precaution was neglected, and the result was that the letters of reference on the drawings are in many cases quite microscopic. Care has now been taken to prevent this mistake, and the results are of course much better. Tints or washes must not be used, except that washes in faint blue (which will not photograph, or rather will photograph white) may be used as a guide merely to show where line shading is to be introduced. A light shade of blue may also be used for any details which it is desired to insert in the drawing, without their being reproduced in the copy. The lines must be firm and clear, the paper smooth and white. The drawing should be rolled, never folded or creased. The ink should be black, Indian ink is most suitable, with perhaps a little yellow added to kill any blue tone.

In some cases it is required to prepare from a silver print a drawing capable of being laid down on stone or zinc. A convenient way of doing this is to trace, on the surface of the photograph itself, the lines, or the principal lines of the drawing. The photograph is then bleached by immersion in a solution of chloride of mercury, or some other chloride capable of acting in the same way. Nothing is then left but the lines drawn by the draughtsman, who is thus enabled to judge of the effect of his work. If he has omitted anything of importance, he can restore the original photograph by immersing it in a solution of hyposulphite of soda. The drawing thus produced can be transferred to the stone, and worked up upon it to any required extent.

A similar plan may also be employed when a reproduction of a plan or map is wanted, in which some of the details are left out. In this case the reproduction will generally be on a smaller scale than the original. The original is photographed, and a silver

print made, the draughtsman then traces over those details which he wishes to appear, bleaches the print, which is re-photographed and the usual process carried on.

Another method of getting the desired result has recently been described by Lieut.-Colonel Waterhouse.[1] He pastes a thin sheet of bank post paper over a copy of the original map. This allows the lines to show through the paper sufficiently well for them to be traced over, but not sufficiently for them to photograph. The draughtsman then traces what is required, omitting the rest. He can also add any fresh details or lettering that may be needed. The tracing does not require to be removed from the original, but the whole is set up in front of the camera. It is obvious that this plan is only available when the original may be spoilt. If the original is of value, and has to be preserved, the only way of dealing with it is to photograph it, and to work on the photograph.

In some cases the drawing is reduced in

[1] Year-Book of Photography for 1886, p. 88.

scale by transferring it on to the surface of a stretched sheet of india-rubber which has been coated with a material capable of receiving the transfer. The sheet is clamped in a frame provided with means for tightening or relaxing the tension as required. The drawing having been transferred in the usual manner from the stone to the stretched sheet, the sheet is allowed to shrink, care being taken that its contraction is equal in both directions. From the contracted sheet the drawing now reduced is re-transferred to a clean stone, from which it is printed by the ordinary methods.

There are various devices for economizing labour by the mechanical introduction of lines, shading or stipple, into drawings for reproduction by photography. One of the most commonly used of these methods is the employment of an enamelled paper having lines printed upon it so as to form a tint. These lines may also be coated with enamel, on which a second series is printed in a different direction to the first.

By the deft use of scrapers of different shapes, the artist can produce points or lines running in various directions, while, by either scraping out the lines entirely or covering them with white pigment, he can get pure whites.

Another of these devices is Day's "Shading Medium," intended for the use of lithographers. In this a grain of any desired character is indented upon a thin sheet of flexible material. The sheet is inked and laid on the stone, when by means of a burnisher the grain can be transferred to the desired parts of the drawing.

When old prints on discoloured paper have to be copied, it is necessary to clean and bleach them, since it must be borne in mind that yellow will be reproduced as almost black in the photograph, and if the paper has anything of a yellow tinge, it is impossible to get the strong contrast between paper and ink, without which success in the process is impossible. Actual stains may be painted out with Chinese white.

For bleaching such discoloured originals chloride of lime or *eau de javelle* is recommended, followed by hyposulphite of soda ("antichlore"). "Holmes' ozone bleach" is also effective, or a weak solution of hydrochloric acid. In any case such treatment requires great care in its application, and in the case of valuable originals it should be left to skilled hands.

Photolithographic prints do not, of course, require mounting, but they have to be inserted in binding, like other lithographs, as they cannot be printed with the type. In the case of some cheap publications the device has been adopted of leaving spaces in the type where the pictures are to come, and, by a second printing, filling in these spaces from the stone. The plan is ingenious, and served its purpose sufficiently well, though it can hardly be said to possess any other recommendation than that of cheapness. The readiness, however, with which any lithograph can now be translated into a surface block, capable of being set up with type, reduces the value of this method

of producing the cheapest possible sort of illustrations.

On the other hand, a transfer can be taken from the type, the drawings can be photographed, and a reproduction of a whole page, text and illustrations, be transferred to the stone. The official publication of the United States Patent Office, which contains selected drawings from the Specifications of Patents, together with abridged descriptions of them, is thus produced. Photolithography has also been employed to produce a small-sized edition of a book from the original edition of larger size. Naturally this would only be worth doing under certain circumstances, as for instance when the original contained much type of an unusual character, or belonging to a foreign language, so that composition was costly or difficult. Recently the large edition of Skeat's Etymological English Dictionary was thus reproduced on a small scale. It is evident that all the trouble of press-correction is thus saved.

For the reproduction of old books in facsimile, photolithography is a most valuable

process, whether the work be done from the stone, or by an etched surface block. The latter plan will generally be used if a numerous edition be contemplated, or if it is intended to reprint. For a small edition the work may very well be printed from stone at once.

Before the invention of photolithography, work of this character was effected by the process of anastatic printing, which was introduced a little more than forty years ago, and for long offered the most convenient means of reproducing printed matter in facsimile. This process was really the origin of the transfer process in lithography, and may indeed be described as a simple transfer process.

In anastatic printing, the printed page, whether type or picture, which was to be copied, was moistened with dilute acid, and then forced down on a surface of zinc. The acid affected the paper only where it was not printed on, the ink of the print being sufficient protection to the paper actually underneath it. The result was a slight

etching of the metal by the acid in the parts in contact with the unprinted portions of the paper, and a slight setting off of the ink in the printed portions. The plate was then gummed and inked in the usual manner, the ink of course only taking on those parts of the metal which had been in contact with the printed parts of the original.

The process was applied with a great deal of success, even to old originals, by soaking the copy in potash, and afterwards in a solution of tartaric acid. Ink was now applied by a roller to the paper itself, when it was taken up only by the printed parts, the fatty ink being resisted by the crystals of the bi-tartrate of potash which had formed in the unprinted portion. The process was used with much success for a considerable time, until its place was taken by the photolithographic processes. Lately, however, some modifications have been made in it which are stated to have rendered anastatic printing again likely to come into use. It will not under any circumstances be likely to be of much service

for the illustration of books, though it may come to be valuable for such purposes as the production of small editions of books which have gone out of print, but for which there exists a limited demand.[1] Reproduction by an anastatic process would be cheaper than re-composition, and the whole cost of correcting for the press would be saved. There would also be the further advantage that the copies would be absolute facsimiles of the original. On the other hand, the special advantage must always be possessed by a photographic method that the original is safe from injury. Owners of a valuable print or a choice old book will always be chary of having it treated in the manner above described, though they may raise no objection to its being set up in front of a camera.

[1] One method consists in flowing over the original page, which has been previously damped, a dilute solution of lithographic ink in benzol. The ink takes on the printed portion, but is repelled by the water in the unprinted parts of the page. A transfer is then taken in the ordinary way.

CHAPTER V.

Methods of Producing Surface Blocks.

THE processes which have been described in the previous chapters can none of them claim to be in the fullest sense adapted to the illustration of books. Book illustrations proper ought to be capable of being produced by the same means as the rest of the book is produced, that is to say, in a printing press. Till within a short time ago, the solitary process which fulfilled that condition was the process of wood-engraving; by it alone could printing surfaces be made which could be set in the midst of type, and printed with it at one simultaneous operation. The arts of wood-engraving and of type-printing may be said to have grown up together. Their

origin was practically identical; the earliest printed books were printed from what we should now consider wood blocks; text and pictures were produced in the same way, and treated in the same way, and the result was a harmonious effect, which can hardly be looked for from any other means.

This harmony of effect is strikingly evident in the oldest printed books which contain illustrations, and it must be admitted that as the processes of wood-engraving have advanced, or if it be not advanced, at all events as they have gradually changed from the simpler forms of the older artists to the more elaborate styles of our own time, so has this harmony between letterpress and illustration been lost. To a search after this lost effect are due the fanciful attempts, in some of our illustrated magazines, at printing the text of a poem within a design, both text and design being the work of the same artist. For the most part, however, such attempts are not very successful, the skill of the old text-writer is gone, the skill acquired only by the constant practice of a

lifetime, and the effect is at best bizarre, if it is lucky enough to avoid being merely grotesque.

Nor does there seem much room to question but that the ancient art of wood-engraving is doomed. For years it has been trying to be anything but itself; to imitate engraving, mezzotint, chalk drawing, anything but wood-engraving. Photographs, and the mechanical processes which have been the outcome of photography, have educated the public eye to a more delicate, more minute style of work than is proper to wood-engraving. The art has endeavoured to compete with its rivals on their own ground, and is being rapidly worsted in the attempt. What will be the ultimate result on the art of illustration, it is not easy to foretell. It is at all events certain that the public taste, influenced principally by photography, has altered a good deal recently. The simple outlines that were once accepted as satisfactory, now no longer suffice. Minute detail is expected, and a softness which can

only be obtained by an absence of strength and vigour. Many of the most admired woodcuts of the present day look like nothing so much as over-exposed photographs. Prints of this nature can never harmonize with type. Some attempt may certainly be observed to assimilate the character of the type to the style of pictures which it is now possible to produce by means of surface printing blocks, and thus to seek after that effect of harmony, which is essential for good and artistic work of every sort. This tendency, however, cannot be carried very far, probably it can get no further than it has already gone, without sacrificing the clearness and uniformity, without which type cannot hope for what is after all its primary object, legibility.

The precise style of illustrations that may be fashionable at any time will be partly a matter of taste, partly dependent on the means at the command of the artist. Public taste will partly guide the artist, but to a much larger extent it will be guided by him. As new methods become available, he

adopts them. If he is skilful, he increases by their adoption the resources of his art. If he is merely anxious to get his results in the easiest way, he lowers the character of his work. The public follows, and gradually comes to admire what it gets used to, what is constantly before it.

At present there is a conflict of testimony as to the value of the newer methods. Those who object to the new processes are not content to put forward the real intrinsic merits of wood-engraving, they urge objections which have no foundation in fact, and naturally therefore damage their own case.

For instance, it is said that in mere mechanical reproduction the beauty which belongs to good original work must of necessity be lost; but this is assuredly not the case. So far indeed is it from being the case, that it is possible, nay easy, to reproduce the actual work of the original artist, more faithfully than if his design had to be translated by the intervention of the wood-engraver, however skilful, since it may be definitely stated that there are now

available processes which will reproduce an artist's sketch in the form of a surface block with the same absolute fidelity as that with which the old process of etching reproduces the design outlined upon the copper.

There are certainly advantages belonging to wood-engraving alone. These come principally from the nature of the material employed. A wood block offers a much finer surface to print from than an electrotype from the same block does. The wood is porous, and absorbs the ink into its substance. With the metal the ink is merely spread over the surface. It is easy to see that the softer material will give a fuller, richer print than the hard, unyielding one. Again, a skilful wood-engraver, master of the resources of his art, and responsible for the whole execution of his work from first to last, will certainly produce better results than can be obtained by any process, of necessity carried out to a large extent mechanically, and by a workman guided by another man's design.

Then, it may be said, there must always be

work for at least the highest class of wood-engravers? So there would, if such a class could exist without there being a more numerous class below it of inferior and average workmen, from whose ranks vacancies in the first class could be supplied. This is obviously unlikely, to say the least of it, and if the ordinary run of illustrations can be produced without the aid of the wood-engraver, the result will be that there will be no wood-engravers to execute the finest work.

With every respect and admiration for the beautiful art of wood-engraving, it must be allowed that it is not a natural, or a free method of reproducing a sketch in black on a white ground. If paper were conveniently made black, and ink were naturally white, possibly artists would have drawn in white on a black ground. This is what a wood-engraver would find it easiest to do, in fact some wood-engravers do get many of their effects by what is practically such a method. As a fact people draw, and write, and print in black on white, and the

wood-engraver follows suit, or appears to do so. He does not in reality. He has a ground that is black, potentially black, to work on, and he digs out his whites till he has so little left that the remains of his black ground look like original black lines on a white ground. If he wants a fine line, such as the draughtsman makes with a stroke of his pen, he laboriously cuts away his block on each side of the line. If he wants cross-hatching, such as the artist makes with half a dozen strokes, and as many more at right angles to them, he has to cut out twenty-five little white lozenges, leaving only the narrow lines of separation between them. No. When the question of originality comes in, the mechanical process has the best of it. You may, if you like, call etching a mechanical process, or just as truly, but it reproduces faithfully what the artist draws on the copper, and the mechanical processes of chemical engraving, phototypy, or by whatever other barbarous name they may be called, faithfully reproduce what the artist draws on the paper.

Of course there is this objection. They reproduce what the artist drew, not what he meant to draw, or indicated as desirable to have drawn. A skilful draughtsman now often leaves to the wood-engraver the interpretation of what is only a sketch, an indication of the idea in his mind. The engraver—an artist too—fills up the details and produces a perfect picture. The picture, however, is the work, not of one man, but of two. The man whose drawing is to be reproduced as it is, without the intervention of another human brain, must finish the work himself—must turn it out just as he wants the public to see it. This means additional trouble, and thence a natural dislike—for artists are quite as human as the rest of us, more so than the average—to "mechanical reproductions."

So skilful have wood-engravers become, that they can translate into the lines of a wood block the tints of a photograph, printed direct upon the wood, or transferred thereto by the carbon or other process, and a good deal of the work for our illustrated

papers is prepared in this way. Much more then can they work from the sketch of a skilled draughtsman who knows exactly the effect he requires, and knows also that he will get it just as well by indicating to the engraver what he wants, as by drawing all the details as they are to be cut upon the wood.

That such translation is quite as easy for phototype work as for wood-engraving is certain. In cases where the artist cannot make the finished sketch himself, as with a special correspondent sending off home any rough memoranda he has time and opportunity to produce, there is no reason why the rough sketch should not be worked up into a finished drawing in black and white, which can be reproduced as a relief block by one of the processes to be described in the following pages.

These processes are of two classes. The first class may be said to depend upon a combination of the ordinary plate-etching process, with one or other of the processes of photographic printing which have already been described. The second class consists

of processes in which the relief obtained by the use of bichromatized gelatine serves as the basis from which a block, having sufficient relief for printing purposes, is obtained.

We shall deal first with the etching process, or, as it is sometimes termed, the process of chemical engraving.

In the usual plate-etching process the lines which are to contain the ink are bitten out by the acid to a sufficient depth. It is not difficult to perceive that if the process were continued, the hollows might by the action of the acid be eaten out to a sufficient depth to depress them below the printing level, and the surface of the plate employed to print from. Of course, to produce a practical printing block in such a manner, the etching ground would have to be removed from those portions of the plate which were required to print white, instead of from the black lines. Such a system for the production of surface blocks has indeed been introduced, under the name of "White-line Etching"; the artist draws his picture

in white on a black ground, and by an etching process, similar no doubt to that which will shortly be described, the whites are etched out, and a surface block produced. Very excellent results have been produced by this device, but, whether from the difficulty of getting artists to work in a manner so different from that to which they are accustomed, or because equally good results can be obtained by other and perhaps simpler methods, the system does not appear to have come into use, though it is now some little time since the inventor brought it out. This seems a pity, for it is both novel and ingenious, while it is capable of producing certain effects in a manner not otherwise easily attainable.

The methods by which a photographic transfer can be obtained for the purpose of photolithography have already been dealt with, and it has also been stated that such a transfer can be placed upon a zinc plate, instead of upon a stone. As the use of a transfer affords one of the simplest and one of the commonest ways of producing a

phototypic block, it may be convenient to deal in the first instance with this method, merely premising that it is by no means necessary that the transfer should be a photographic one. Any outline that can be produced in a suitable fatty ink will serve equally well to take the place of the etching ground, and protect the surface of the plate from the etching fluid, for that is really what is required. One special convenience of the process is that, as with photolithography, a proof of the picture can be submitted from the stone, and any required alterations made, before the block is etched, an advantage which cannot be had with a wood block.

And here it may be well to point out that, as with photolithography, only drawings in pure black and white can be produced. A tint cannot be represented, any more than it can by a wood block. Later on we shall have to deal with devices for rendering into line or stipple or granulation the half-tones of a negative, but for the present we are dealing only with reproductions of black and white.

The transfer, in whatever way produced, is damped and laid on the smooth and carefully prepared face of a zinc plate, zinc being preferred to any other metal on account of its cheapness, and for its ready solubility in the acids used for etching. This is naturally of special importance, since large quantities of the metal have to be removed, and removed with rapidity. Under these circumstances copper is much less suitable, though, as we shall see hereafter, it is capable of being used in some cases, especially with very fine work, with effect. Zinc is also preferable on account of its "lithographic" qualities, its power, that is to say, of taking up both the ink and the water. Copper is a denser, more close-grained metal, and therefore not so suitable. Type-metal (an alloy of lead and tin, with a little antimony) has also been employed. Cast-iron would also serve, but the writer has not heard of anybody who has had the hardihood to propose to etch cast-iron. The idea may have some value, since it must be one of the very few connected

with the subject of photo-typography still remaining unpatented.

By being passed a few times through a lithographic press, just as if the transfer were for photolithography, it is caused to adhere to the plate. The paper is then wetted, after which it can be stripped off, leaving the whole of the ink on the plate. The amount of ink, however, thus deposited on the plate is not in itself sufficient to offer the requisite protection from the acid, nor is the transfer ink of a nature capable of resisting the acid. The plate is therefore inked up, much in the same way as a lithographic stone is inked up, with a view of rendering the lines as solid and as strong as possible. That is to say, it is washed, gummed, again sponged over, and then rolled up with a suitable ink. The process is repeated until a sufficient amount of ink has been taken up by the lines, that is, in fact, as much ink as they will hold. The covering of the lines is then still further strengthened by dusting over the plate powdered asphalt or other suitable

material, the plate being warmed just sufficiently to incorporate the asphalt with the ink. The back and other parts of the plate, where the acid is not required to act, are protected by varnish, and the plate is then placed in a bath of acid, in order that the parts not covered by any protective coating, the parts, that is, which are to form the whites of the finished picture, may be dissolved away.

Now comes the principal difficulty of the process, and one which for long formed the chief obstacle to its practical use. If the acid were allowed to act continuously on the plate until a sufficient depth had been obtained, it would not content itself with eating straight down into the plate, but it would act on the sides of the furrows it formed as well as on their bases, and would consequently undercut those parts of the plate which were covered by the protecting material. The result would be that the fine lines, being undermined from both sides, would disappear altogether, while the strongest lines and

the edges of the solid blocks would become rotten. The way in which this difficulty is overcome is highly ingenious, and it has the further advantage of acting on the metal in such a manner as to leave the lines supported on a broad base of metal, each line being in section an inverted V, and having thus, however fine it may be, strength sufficient to stand the pressure to which it is subjected in printing.

As soon as the etching has proceeded to a very slight depth, the plate is removed from the bath, washed, and gently heated. The ink and the other protective medium is thus melted, and caused to run down the sides of the little furrows formed by the acid, and thereby protect them from further action. It is obvious that this is a process of great delicacy, and requiring careful watching, since the ink is only allowed to flow far enough to protect the sides, without covering the bottoms of the hollows, or extending beyond the sides. It is, however, successfully carried out, and seems to present no difficulty to the skilful workmen

employed. The process of inking and dusting on resinous material is repeated, and the plate is then ready for a second etching. The action of the acid in the second etching also is only permitted to reach a very slight depth, when the plate is removed and treated as before.

So the process goes on till a depth which it is considered will give satisfactory results in the printing press has been attained. By that time hollows have been eaten away, the sides of which are composed of little ridges or steps, each step marking the progress of one etching. The last etchings are allowed to proceed to a greater depth than the earlier ones, stronger acid being employed, and the process being allowed to continue for a longer time. The number of etchings, and the amount each is allowed to do, depend on the character of the work to be produced. In fine work the etching is much more gradual than in work of a rougher and cheaper character.

The etching is carried on in baths or troughs to which a rocking motion is given.

The object of this is to cause the acid to flow to and fro in waves over the surface of the plate, so that it may wash away the little bubbles of gas formed by the action of the acid on the zinc, and may also carry off the small particles of foreign matter which, as they are liberated from the zinc by the corrosion, tend to settle on its surface, the effect of either gas or solid matters being alike to protect the zinc, and so to prevent the acid from getting free access to it.

A final etching is given after the block has been cleaned and properly inked up in such a way as to protect only the surface, so that the edges of the little ridges may be eaten away and thus rounded off. Where large spaces of white occur, the metal is cleared away with a graver, to insure their being lowered to a sufficient depth, and thus to avoid risk of their printing. Very often much of the depth is obtained in this way, only just the amount of work that is absolutely required being done by the acid. In large establishments special machines are used for the purpose. Other makers, however,

prefer to get the whole depth required by etching, and leave nothing to be removed mechanically. The superfluous metal round the edges of the design is cut away with a saw, and the plate mounted on a wooden block of such size as to make it "type-high," and therefore suitable for being made up with type in the ordinary way.

In practice it is usual to lay down several subjects on one plate of zinc, if the pictures are all small, for it must be remembered that the size of the surface etched is quite immaterial. It is as easy to etch a large plate as a small one, or a plate with half a dozen pictures on it as a plate with one.

CHAPTER VI.

Methods of Producing Surface Blocks (*continued*).

THE transfer process, however, though offering many and considerable advantages, is not suited for the finest kinds of work. For these it is requisite to print direct from the negative on the zinc, which is of course coated with a sensitive film. The finest results are obtained by the employment of bitumen. Next, perhaps, to this comes bichromatized albumen. Gelatine is not now much used, as albumen gives finer results, and is more rapid. Other colloid substances in combination with a bichromate are also employed. In the choice of the precise process, operators are guided by their own practice, and opinions differ as

to which is the best. The general belief appears to be that expressed above, but some operators prefer albumen to bitumen. When the direct process is employed, the facility afforded by all lithographic processes, or processes into which lithography enters, of giving proofs which can be altered to any desired extent, no longer exists, nor can original drawings on transfer paper be utilized. The process becomes in all cases a photographic one. The drawing must be photographed and a negative obtained under which the sensitive surface can be exposed to light. As in the case of collotype, reversed negatives have to be employed. The negatives also must be of the same character as those for photolithographic work,[1] that is to say, the lines of the drawing must be represented by lines of clear glass, and the whites by as dense a deposit as can be obtained. Negatives of this character, showing intense contrast of black and white, are more easily obtained by the wet-plate process than by the use of dry

[1] See *antè*, p. 65.

gelatine plates, and for this reason the wet-plate process is still generally employed, this being, perhaps, the only important application of photography in which the wet-plate process has not yet yielded to the dry plate. Some workers, however, are successful with gelatine plates, and probably their greater convenience will eventually cause them to be employed almost exclusively here, as in nearly all other photographic work.

If indeed this is to be the case, the makers of such plates will have to use glass with a flatter and more accurate surface than at present, for it is easy to see that unless the surfaces of glass and metal are alike equally true, perfect contact between them cannot be obtained, and imperfect contact of course produces want of sharpness in the resulting outlines. This may indeed, to a certain extent, be guarded against by taking care that the light by which printing is effected falls vertically on the face of the negative, thus throwing a sharp shadow on the sensitive surface, instead of the shadow with indistinct edges which is naturally produced

by diffused light when the object forming the shadow is at any distance, however slight, from the shaded surface. It is, however, better and safer to make sure that the two surfaces are really in contact, and for this purpose to employ proper glass for the negative.

One important advantage of the direct process is that the final picture is not liable to the slight distortion which arises from unequal stretching of the paper in all processes in which the image is transferred from paper. This distortion, slight as it is, is often sufficient to throw the picture out of exact scale, and renders the transfer process objectionable when minute accuracy is necessary. When the image is printed direct from the negative upon the ultimate printing surface, such distortion is evidently impossible.

Reference has already been made to the use of bitumen in the photolithographic process, and the same material affords a ready means of producing a phototypic block. There is this of special interest

about the process, that it was one of the earliest of all photographic processes, and certainly the earliest by which any attempt was made to obtain a printing surface by photographic means. Niepce, the father of photography, produced a photograph by exposing in the camera a metal plate covered with a thin layer of bituminous varnish. As he had expected from his previous observations, those portions of the layer on which light fell were hardened, while those parts were unaffected which had remained in shadow. It is unnecessary to say that to obtain this result an enormously long exposure was required. By the application of a solvent such as had been used in the manufacture of the varnish, the soluble parts were cleared away, and an image formed in which the shadows were represented by bare metal, and the lights by the varnish. To convert this negative image into a positive, the exposed metal was darkened by exposure to the vapour of iodine, and the varnish was cleared off by a stronger solvent. Niepce de Saint Victor,

the nephew of Nicephore Niepce, endeavoured to apply this process to the production of engraved plates, and published a work on the subject.[1] He exposed a metal plate coated with bitumen under a transparency, so that the lines were protected from light and were therefore left soluble. Treatment with a solvent exposed the metal in the lines, and etching in the usual manner produced a plate which could be printed in a copper-plate press.

A process in principle almost identical with that of Niepce, though considerably modified in its practical details, is now largely used for the production of photo-type blocks. The chief objection to this process was originally the length of exposure required, but this is now overcome by treating the bitumen in the first instance with ether, by which the insensitive portions are dissolved out. The remainder is dissolved in turpentine, and the varnish thus obtained is employed

[1] Traité Pratique de Gravure Heliographique. Paris, 1856.

to coat the zinc plate. The device by which an even coating is obtained is highly ingenious, and is applicable not only for coating a plate with bitumen, but whenever a very thin and even film is required. The plate to be coated is clamped on a "whirling table," a disc mounted on a vertical spindle, and capable of having a rapid rotary motion imparted to it. A little of the bituminous compound is poured upon the plate, which is then rapidly revolved. The centrifugal force causes the liquid to fly outwards and spread itself in a thin layer over the plate. When it is dry, the plate is exposed behind a negative for a suitable period, a reversed negative being, it will be remembered, necessary. It is next treated with a solvent, which may be a mixture of oil of turpentine and benzole,[1] the proportions being varied as required, since benzole is a more active solvent than turpentine, and therefore by adding more or less of it, a developer of

[1] Bolas, Cantor Lectures, *Journal of the Society of Arts*, vol. xxvi. p. 819.

any necessary strength can be obtained. As soon as the development is complete, the plate is very carefully cleaned, it being obviously necessary to remove all traces of the varnish or the solvent from the uncovered spaces of metal. This removal of the last traces of the coating is one of the difficulties of the bitumen process. A certain amount of rubbing is necessary, and this is very apt to endanger the finer lines. It has to be remembered that the parts exposed to light do not become absolutely insoluble. Their condition is only one of relative insolubility, as compared with the shaded parts. Both are to a certain extent affected by the solvent, and consequently even the hardest parts are not in a condition to stand rough treatment. When the cleansing process is complete, the plate is generally again exposed to the light, so as to completely harden the film, and it is then submitted to the etching process previously described. The bitumen coating being a better protective from the acid than the fatty ink of the transfer, the plate can be placed

in the bath for the first etching without any further protection. After this the process is identical with that employed when a transfer is used.

When a colloid substance is employed, albumen, as stated above, is generally preferred to gelatine. The mixture of bichromate, albumen and water is poured on the carefully cleaned zinc plate so as to give a very thin film; to ensure evenness, the whirling table, or some similar arrangement for giving a rapid rotation to the plate, should be used; the film is dried, and is then ready for exposure. The time for the exposure, as indeed is the case with most other photographic printing, has to be learned by experience. When the exposure is complete, the development is effected by simply placing the plate in water; before doing this it may be inked over, in which case the image is seen in ink, as the soluble albumen dissolves away from the other portions, or, if the ink is not applied, it is well to add a little aniline dye to the water, in order that the image may be stained, and so

rendered visible. The etching may be effected, at all events the first etching, by using a solution of perchloride of iron, and if an alcoholic solution be employed, the first etching can be effected without inking up the image, the albumen alone being sufficient protection. The later stages of the etching must be conducted in the manner previously described.

Another valuable material for use in preparing a sensitive film, and one perhaps less commonly known than albumen, is honey (it may be worth mention that the rarer sort of honey, that produced by the bee, alone will serve, the ordinary compound of glucose sold as honey in the shops will not answer). The compound of honey and bichromate requires special treatment, and the process varies in some of the details from that usual with albumen. In the hands of some operators a greater speed can be attained with honey than with albumen, and this additional speed, when the work has to be carried on in dull winter weather, or even, as is now often

the case with newspaper work, at night, by means of the electric light, is a most important point. With a good negative, and a well-prepared film, whichever compound be employed, a print can be obtained in ten minutes by the electric light. Three or four hours will suffice for the etching, and thus, in cases of pressure, a block can be ready for the printing press in five or six hours.

Yet another method of etching, and one differing very considerably from any of those yet mentioned, is that to which the name of "silver-line" has been given. It was patented some years ago in Germany, but does not appear to have been worked there, in consequence of certain difficulties in its practical working; these difficulties are believed now to have been overcome, and the process is at present being successfully worked in this country. Those who are engaged upon it speak highly of its capacities, and some specimens of the prints produced by this means, which have been shown to the writer, leave little to be desired.

A zinc plate, covered with bitumen or other sensitive compound, is exposed under a transparent positive, so that the lines only of the picture are left soluble; after development in the usual manner, the lines are etched out, the acid being allowed to penetrate to what is found to be a sufficient depth, and also permitted to undercut the sides of the lines. The varnish or other protective covering is then entirely removed from the plate, and the lines filled in with a metallic alloy, capable of resisting the action of the acid. Owing to the undercutting of the acid, the lines of alloy thus formed are rather broader at the base than at the top. The surface of the plate is then scraped away, down to nearly the level of the base of the etched lines. The reduction of the plate is carried to such an extent that a thin layer of the alloy is left, in the lines originally etched. The plate is then placed, without further treatment, in the usual etching bath, and etched as deeply as is safe without the risk of undercutting. Owing to the comparative thickness of the lines of

alloy, and to their being imbedded within the substance of the zinc, the first etching may be carried to a much greater depth than when the protective layer is only on the surface of the plate, and when it therefore offers no resistance to the undercutting action of the acid. After this first etching the plate is inked, and the process continued in the usual manner till sufficient printing depth has been attained.

By the use of a somewhat similar method, it has been proposed to convert intaglio plates into surface blocks. The lines in the plate are to be filled up with a suitable composition, and the metal etched away. Whether the plan has ever passed beyond the theoretical stage, the writer has no means of knowing. Various other devices for obtaining etched blocks have also been put forward, but those previously described comprise all that are known to be in use, and there is little reason to believe that any of the methods worked as secret processes differ very greatly from them.

To assist the process of etching, the aid

of galvanism has been occasionally called in, with the view of lessening the time required to eat away the metal to the needful depth. The simplest plan adopted with the view of setting up galvanic action is to flow over the plate, before it is placed in the etching bath, a solution of sulphate of copper; the zinc is instantly coated with a film of finely divided copper, in fact what electricians term a "Copper-zinc Couple" is formed, and when the plate is placed in the acid, the action is far more energetic than when the zinc alone is submitted to the acid.

Or the plate to be etched may be connected to the negative pole of a voltaic battery, and another metallic plate connected to the positive pole, both plates being immersed in a suitable etching fluid such as sulphate of copper or of zinc, for instance. The metal is rather rapidly dissolved from the parts not protected by the ink or varnish.

Or, again, the zinc plate to be etched and a plate of copper may themselves be formed into a voltaic battery by immersing them in

a suitable fluid and connecting them by a wire, the action then is the same as in the last case.

Various plans have been suggested for protecting the parts of the plate to be left in relief. Thus the plate may be gilt, and the design incised by a graver, or, after the design has been obtained in any protective coating, the plate may be gilt. The removal of the varnish then leaves the ungilt parts exposed to the corrosive action of the bath.[1] In practice, however, it is not thought that any of these devices offer any advantages over the simpler etching method, and they are not so perfectly under control.

If, however, this principle is to be employed, perhaps the most ingenious application of it is that of Mr. Warnerke. In Capt. Abney's Treatise on Photography[2] an illustration is given produced by Mr. Warnerke's method; but at the time of the publication of that book the method was

[1] A. Watt, "Electrodeposition" (1886), p. 152. G. Gore, "Electro-metallurgy (1877), p. 231.

[2] Treatise on Photography (1878), p. 185.

a secret one. Mr. Warnerke has since been good enough to furnish the author with particulars. He takes a plate of copper or zinc —by preference the former metal—on which a picture in bitumen has been obtained, and flows it over with a solution of a salt of platinum, nickel, or cobalt. Other metals will serve, but the most effective results have been produced with those mentioned. The metal is deposited in a fine state of division on the exposed parts of the plate, which is then placed in a bath of extremely weak acid—so weak that it would have no effect on zinc or copper alone. Action is set up where the metal has been deposited, and the plate can be etched away till a printing depth has been obtained. The bitumen is not needed as a protection from the acid, merely as a means of getting the deposit in the place required, and this once done, the bitumen might be cleared away. If a series of lines, or an outline, be traced with the metallic salt on a clean plate of zinc or copper, and the plate be immersed in the weak acid solution, the

lines will be etched, the rest of the surface remaining bright and unaffected. In this case the whole etching is carried out at a single operation, and Mr. Warnerke states that there is no undercutting effect, the etching proceeding merely in a vertical direction. For cheap commercial work the process cannot compete with the ordinary zinc etching process in the matter of price, but in the hands of the inventor very good work has been produced by it. Blocks made in this way have been printed in some foreign periodicals, but the process has never come into any extensive use.

An attempt has been made to substitute glass for zinc in the preparation of surface blocks by the etching method. The etching in this case is effected by means of hydrofluoric acid, as in the ordinary process for etching glass, the protective film being applied in the usual way. So far as the writer is aware, no details for the carrying out of the process have been published. The brittleness of the material is an obvious drawback, possibly compensated for by its

comparative cheapness. The surface would be quite true, and would require no preparation. The process has been introduced commercially, but it does not appear to have attained any amount of success. It was proposed to use it for large pictures for illustrated newspapers, and to some extent this was done in a paper published in Australia.

We now come to the second class of processes by which phototype blocks are made, processes of some importance, though less extensively used than the etching methods. These are exclusively photographic, as transfers or drawings made by hand cannot be employed. If a sheet of plate-glass covered with a film of bichromated gelatine be, after exposure under a line negative, soaked for a considerable time in cold water, the parts protected from light will swell up, and the lines will consequently appear as depressions. A plaster cast, taken from the wet swelled gelatine, will reproduce these depressions as raised lines. A reproduction of this cast in metal

will consequently be a surface printing block. This reproduction is most easily effected by taking another cast from the plaster, and then electrotyping, or by electrotyping from the plaster, and making a second electrotype from the first one. Additional relief may be given in large spaces of white, by depositing wax, stearine, or some other easily fusible material on those parts of the mould requiring to be raised in order to give deeper depressions in the block. "This is best done by holding a stick of stearine or wax in the left hand, and a warm pencil of metal in the other hand, and so holding the wax or stearine as to let a thin melted stream flow down the warm pencil."[1]

There are special difficulties in the way of carrying out the process, and blocks made in this way are generally considered to be much inferior to etched blocks; the edges of the lines are inclined to be rounded, instead of being square, and the

[1] Bolas, Cantor Lectures, *Journal of the Society of Arts*, vol. xxvi. p. 805.

surface of the metal is less truly even than the surface of an etched block; this will easily be understood when it is remembered that in the latter case it is the surface of the original plate of zinc, which had been carefully smoothed, whereas in the former case the surface results from the level of the unswelled gelatine, and this, though fairly even, is not absolutely so. The writer is not aware whether any process, founded on this principle, is in actual use.

Again, if the exposed film be developed in hot water, the soluble parts can be entirely removed. By exposing under a positive, the lines may be left soluble, and then after development we get a mould, the base of which is the surface of the plate glass, and is consequently perfectly even and true. A process of this nature is successfully worked by Messrs. Dawson, whose wax process for the production of relief blocks is described later on.[1] They have, by the method they employ for the production of the swelled gelatine

[1] See Chapter XI. page 215.

film, succeeded in getting a very satisfactory and sharp relief, though it is a very low relief. From this they take a cast in plaster, and from that a cast in wax. This wax cast is then carefully worked over and additional wax is run on to all the parts where additional depth is wanted in the printing block. The practice acquired in the Dawson wax process has doubtless given the operators considerable skill in this department of the work, and the results are certainly extremely good.

It will be seen that these processes, whether the etching method or any other be employed, provide us with a most important and valuable means of illustrating books. By their aid any drawing or design in line or stipple can be translated into a solid block, and with such success that with suitable subjects it is often hardly possible to tell the original from the copy. And not only do they enable surface blocks to be produced with great rapidity and at slight cost, but they give blocks capable of producing effects which could not be

obtained at all by wood engravings, or if at all only at a great expense. A familiar and obvious instance of this may be found in the diagrams with which scientific books are illustrated. At one time it was the usual practice to construct such diagrams of white lines on a black ground, like drawings on a slate. The reason for this was that it was easy for the wood engraver to cut out a white line, leaving the remaining surface of his block untouched; while it was very troublesome for him to cut away the whole surface of his block, leaving only the few thin lines required to form his diagram. Now, however, by the etching process, it is just as easy, in fact it is rather easier, to produce a block which will print the lines in black. This is a simple case, but an extension of the same principle, that (within certain limitations) the character of the lines is of no great moment, gives automatic or chemical engraving its great advantages over wood blocks. As a *tour de force*, wood engravers have sometimes copied etchings, but with a result by no

means commensurate with the labour expended. Now an etched block will render with equal facility the diagram of a problem of Euclid, a page of type or manuscript, a pen-and-ink sketch, an etching, a mezzotint, or a copper-plate engraving. An artist ought therefore to be able to express himself with much greater facility than when he is drawing for the wood-engraver, and there need be little doubt that when the different processes have been a little more improved, and have reached the perfection they are rapidly approaching, he will be able to do so.

Also it is of little or no consequence how elaborate or complicated the original design may be. If it is photographed, it is of no consequence at all, and if it is drawn, it is far easier to copy a complicated line drawing upon the stone than it is to translate it into a woodcut.

The process of making a block by the etching or other photographic method is one requiring great skill and great care. The theory is simple enough, but the practice is extremely difficult. That the finest results

may be attained in it is shown by the exquisite illustrations in many of the magazines illustrated by "process" blocks, while its rapidity is another great advantage. For diagrams and line subjects it is excellent. For pictorial effects it can hardly, as yet, be said to come up to the best wood-engraving, though it is rapidly coming up to this standard. The finest blocks now produced are indeed nearly or wholly free from the flatness or greyness which was the objectionable feature of the earlier prints; but even now, where the finest results are desired, and the cost is not a matter of special consideration, it will be best to rely on the wood engraver. He can still give us brighter and clearer work than his more modern rivals, though there is not much likelihood of this remaining so for any length of time. In the various processes that are necessary for the production of relief blocks by any of the methods described, there are many risks to be run. In inking up the transfer, lines sometimes get thickened out, especially at

their ends. On the other hand, in etching, the lines get eaten away, so that they become rotten, and sometimes they entirely disappear.

There is also a great tendency for the lines to become rotten owing to their edges not being entirely protected by the ink and other materials, and also to the ink having been allowed to cover rather too much of the metal after the first etchings, so that little projecting ridges and points of metal are left by the side of the lines, and almost the same height, so that they print. These faults are not, however, to be found in good work, and, unless when the blocks are made in a very great hurry, they ought to show perfectly sharp firm lines. The time taken in the production of a block is not very long; a few hours will suffice for the etching, depending to some extent upon the character of the work, for with fine work the etching, especially in the earlier stages, has to be carried out more gradually, and with weaker acid, than is permissible with work of a coarser character.

In the swelled gelatine methods the difficulties arising in the chemical processes for dissolving away the metal are of course avoided. In these the chief difficulties appear to be found in the preparation of the film. There is no fear of rotten lines, the tendency seeming rather to be to coarsen the work. Sufficient relief is not easy to get, and, except in very skilled hands, the lines are apt to be deficient in strength from a lack of sufficient base of metal.

These defects, however, will not be found in good work, and process blocks are to be thoroughly recommended for illustrations, at all events in which artistic beauty is not the first consideration. They can be trusted to reproduce faithfully in a form capable of being printed simultaneously with the text any picture capable of reproduction by any known printing process.

Naturally their most important application is for the production of blocks from original drawings made specially for the purpose. When such drawings are properly prepared, and with an intelligent appreciation of the

method in which they are to be reproduced, illustrations of the most satisfactory character ought to be obtained.

The proper conditions under which successful reproductions can be obtained are getting to be pretty generally understood, and many artists now find it worth their while to devote themselves specially to this branch of their work. By skilful employment of the various resources at their command, using the special process which is most applicable, or even laying several different methods under contribution, the best results are to be had.

Those who have no experience in the preparation of drawings which are to be reproduced as surface blocks, cannot do better than follow the directions given for making drawings which are to be copied by photolithography.[1] If an artist is employed, and the originals have to be drawn, not photographed, the draughtsman is often expected to work from very rough sketches indeed, and if he is a skilful

[1] See *ante*, p. 71, and Appendix I.

artist, will generally turn out satisfactory work from the crudest suggestions. If an author is capable of drawing on transfer paper, he can himself prepare his own drawings, and these can be transferred direct to the zinc for etching. Naturally, the cost of such illustrations is reduced, but it is only in exceptional cases that the results are equal to those produced from the work of an expert lithographic draughtsman. When the author prepares his own drawings, it will generally be safer to make them carefully in black ink on smooth paper, following the instructions given, and to have the originals photographed.

The question will often arise whether it is better to employ lithography for some particular illustration, or to have a block made. If the illustration, whether it be a picture, a map, or diagram, be large, there is no choice. The size of a block to be printed with the text is limited by the size of the page, and if it is not to be printed with the text, there is not (except for very high numbers) much gain in printing it in

the press instead of from the stone. Any saving in the printing will be absorbed by the cost of making the block. On the other hand, if the illustration be very small, it must be set in the text, and must therefore be a relief block.

If the illustration is to be about the size of the page, other considerations come in. For moderate numbers it will in most cases be better to rely on lithography. As the pictures are printed separately from the text, suitable paper can be used, tinted if preferred; the cost will be a little higher, but the results will be more satisfactory.

If the cost is a matter of great importance, and it is proposed to print a large edition, there will be a decided saving in the use of blocks which can be printed with the type. There is also this important consideration that they are ready for future editions, whereas the lithograph will in most cases have to be drawn afresh. The cost of preparing the principal illustrations over again is often sufficient to prevent the issue of a second edition of a book.

CHAPTER VII.

Production of Type-blocks from Half-Tone Negatives.

THE production of printing blocks, or of intaglio plates, direct from an ordinary photographic negative, containing not merely blacks and whites, but intermediate shades also, was for a long time the *crux* of those who devoted themselves to the subject, and it is only quite recently that any very marked success has been attained, at all events in the former of the two attempts. The production of prints from plates, the preparation of which was at all events in large share due to photographic methods, however much the etching needle or the graver might afterwards assist, has now for some years been a successful branch of trade, but it is only

within the last year or so that surface blocks have been produced from half-tone negatives on anything like a commercial scale.

Several ardent experimentalists have, it is true, long been working at the problem, and they have from time to time produced very remarkable results, as a matter of fact not greatly inferior to those of the present time. None of these, however, could justly claim more than an experimental success, and it has been reserved for others to bring to perfection, or very near perfection, the methods they originally devised.

The object of some of these earlier workers was to produce a lithographic surface. Others sought to make relief blocks, but as the end they really sought was identical, the breaking up into grain or stipple the graduated shades of a negative, it is not easy to discriminate between their labours. Many of the devices intended for photolithography have resulted in the production of surface blocks, and one at least of the most successful methods of making a photolithograph from a half-tone negative

is based on an invention intended to serve for relief blocks. Amongst the latter class should be mentioned Pretsch, Dallas, Asser, Leggo, Woodbury, and Husnik; amongst the former Bullock and Swan. All of these produced working processes, and processes by which extremely good work could be and was produced. Most of the recent methods indeed are founded on the work of these men, and of others who equally deserve recognition; often the resemblance is so close that the difference consists only in small details, hardly capable of description.

Many of the processes, too, are being worked as trade secrets, partly no doubt because of the difficulty of obtaining valid patents for them when so much has been published, and when so many closely allied processes are already public property; and partly because the difference between success and failure consists to a large extent in the observance of minute details, of which, even were they protected by a valid patent, it would not be easy to detect an infringement.

Under these circumstances it would be unreasonable to complain of manufacturers who adopt a perfectly legitimate course for the protection of their own interests, though it may be a natural source of regret, to those who only take a scientific interest in such matters, that much information of an interesting character should thus be unavailable. There is, therefore, the double difficulty in writing on the subject, that in the case of some processes the information is really not accessible, and in the case of others it cannot be given without infringing upon what at all events the users of those processes believe to be private rights. It is hoped that the following pages will contain enough to give their readers sufficient general information on the whole subject, without unduly trespassing on trade privileges.

It is perhaps unnecessary to remind the reader that the problem to be solved is the translation of the light and shade of the negative into solid outlines of black and white. The shadows may be solid black and the whites solid white, but the

intermediate shades must be lines of various breadth, or of varying distance apart, or spots or grain of various fineness or closeness. In a surface block any part that touches the paper prints, any part that does not touch the paper leaves no mark at all; there is nothing between, no slight touches or faint impressions. Certain effects may, it is true, be gained by slightly "lowering" the surface of the block, or by "overlays" which increase the pressure of the paper on certain parts. These devices, however, though most important in improving the lightness and the delicacy of the picture, are quite insufficient for the purpose of giving different tints or degrees of shading. Nor has the surface block the resource of the intaglio plate, the deep lines of which hold a large proportion of ink, and transfer it to the paper, while the shallow lines, holding a less quantity of ink, can only deliver that to the paper, and consequently make a lighter impression.

The photographic image is of course continuous. There are no outlines in it.

The picture is formed of graduated tints or shades, ranging from the white of the paper up to the darkest colour that the process employed can give. In a wood block lines are employed more or less freely to indicate the outlines of the design. Such outlines are employed with the greatest freedom by the early wood-engravers, sparingly by Bewick and his school, very little by the most recent school, whose object appears to be to give as closely as possible the character of a photograph, or at all events of a type block produced from a photograph. To make a block capable of being printed from, the graduated tints of the photograph have to be translated into shading, which will, as far as possible, give the same value. The image must be broken up into stipple or grain of some sort, and it must be a stipple closest in the shadows, gradually becoming more open through the range of the intermediate tones, and vanishing altogether in the highest lights.

For a typographic block the relief, too, must be considerable, and here is one of

the greatest difficulties. The best relief blocks now made direct from half-tone negatives are very far from being satisfactory in this respect. They are not nearly deep enough, and they consequently require the most careful and delicate printing. For ordinary printing the paper is damped, and it is forced down on the type by a cylinder covered with a slightly yielding material. The type is thus pressed a little into the paper, as may be seen on looking at any roughly printed sheet, when the depressions formed by the type are evident enough. Treatment of this sort applied to one of the modern tint blocks generally results in the production of a black smudge. The paper has to be dry, and the cylinder over which the paper passes must have a firm unyielding surface. The paper must only touch the top of the printing surface, there must be no burying of the lines of the block in the body of the paper. Printing of this character must always lack something of the richness and vigour of the old style, however much it may gain in delicacy.

And this necessity for an improved method of printing was one of the reasons why it is only quite recently that tint blocks have come into use. It was no use making delicate blocks if nobody could print from them, and so, though really excellent work was produced by the inventors named above, their inventions languished, as so many inventions languish, because they were a little ahead of the practical appliances by which they were to be used.

And the same may be said of the attempts to produce photolithographs in half-tone, which preceded the endeavour to make type blocks. Before these systems could be used improvement was necessary in the printing appliances, and besides this greater skill was needed on the part of the workmen. The extended use of lithography, and the various processes to which it is now applicable, have developed a wonderful amount of dexterity amongst those who have to carry out these processes, and a consequent facility for the execution of processes still more delicate and difficult.

Many of the processes with which we are now concerned are most suitable for photolithography, many others are intended for the production of type blocks. As, however, it may be considered that any lithograph can by the transfer method be reproduced as a block capable of being printed with type, and that conversely a print can be obtained from any type block which can be transferred to the lithographic stone, it will be convenient if in this chapter we consider rather the question of translating half-tones into grain or stipple, without reference to the particular manner in which the actual printing is to be effected, and if, therefore, we deal with photolithographic processes in half-tone, as well as with type blocks. Such a course will save inconvenient repetition, and it is to be hoped will not cause any confusion.

No attempt will be made to describe, or even to enumerate, all the various processes which have been proposed, and this will be the less necessary because, as far as is known, they all of them rest on a few

well-known principles, though there has been great ingenuity in the manner in which those principles have been applied.

Most then, if not all, the successful processes for the purpose depend on one or other of the following methods, or on a combination of one or more of them.

1. The natural reticulation of the gelatine or other colloid film, in the parts exposed to light.

2. Copying mechanical network, stipple or grain on to one of the sensitive surfaces used in the production of the printing surface, or introducing granular material into the substance of one of those surfaces.

3. Imparting line or stipple to a Woodbury film or analogous relief.

There are some other processes available for the manufacture of type blocks,[1] but those given above are believed to be almost exhaustive, except as regards methods intended primarily for photogravure, some of

[1] For some of these see the articles on the subject by Lieut.-Col. Waterhouse in the volume of the *Photographic News* for 1885 (vol. xxix.).

which may very probably hereafter suggest means for the purpose. These methods will be considered in a later chapter,[1] devoted specially to the means employed for producing intaglio plates from half-tone negatives.

One of the oldest processes for the production of grained blocks direct from a negative was that of Paul Pretsch. He discovered the fact that the bichromatized gelatine film, in addition to the properties of which so much has already been said, possesses also the property already mentioned[2] of reticulating or covering itself with minute vermicular markings, when it is wetted after the usual exposure to light. This property is specially apparent when the film has been rather rapidly dried, and when it contains a proportion of a deliquescent material, such as chloride of calcium. The reticulation varies considerably in its character, according to the temperature at which the film has been dried, its thickness and its composition.

[1] See Chapter X. [2] See *ante*, p. 51.

Its amount also varies precisely as the amount of exposure to light. In the shadows of the highest lights of the picture, where the protection from light by the darkest parts of the negative has been complete, there will be no reticulation at all, and the gelatine having preserved all its power of solubility will swell up, when the film is soaked. In the highest shades of the picture, where the light passing through the clear parts of the negative has acted most strongly, the gelatine will absorb no water, and here also there is no reticulation. In the intermediate shadows a graduated amount of reticulation will be found, slightest and most open when the light has acted slightly, and increasing to a certain point, after which it begins to merge into the solid shadows of the picture.

We have therefore, after exposure and soaking, a film with the high lights raised and smooth, the middle tones partly raised and grained, and the solid blacks depressed and smooth. A cast from this represents

a typographical block of the character required.

If therefore an electrotype be taken direct from the wet gelatine, the block is obtained at once, but as this is not an easy process, it is better to take a cast from the gelatine, and to reproduce this by a double electrotyping or by casting again and electrotyping.[1]

The Pretsch process, though a very old one, has many advantages, and, if a demand should ever arise for the production of type blocks for newspaper work direct from original negatives, there is perhaps no process likely to give better results. The grain is extremely good, and the worm-like markings work themselves in a wonderful manner into the details of the negative, aranging themselves along the lines and following out the finer outlines.

As Major Waterhouse observes, "The

[1] The best account of the Pretsch process is given in the *British Journal of Photography* for 1879, p. 567. A formula for it is also given in the *Year-Book of Photography* for 1885, p. 191.

only objection to it (the Pretsch process) is that the grain may become unduly prominent, and destroy fine detail, but the general effect is good." For this reason it is not very well suited for fine work; at all events better results can be obtained by other means, but for bold rough work it has many advantages. Probably the finest example of a Pretsch block is one which was printed as an illustration of the process in the *Photographic News*[1] in 1883.

This was printed in the ordinary manner on a newspaper machine, and is certainly an admirable example of the suitability of the process for producing newspaper illustrations direct from a negative, should such a process ever prove to be required.

Another process by which similar results can be obtained is Asser's starch process. This is a transfer process, in which starch takes the place of the gelatine usually employed. Paper is covered with a thin film of starch or of flour paste, spread on with a brush, and is then immersed in a

[1] *Photographic News*, 1883, p. 386.

weak solution of bichromate of potash. After exposure the paper is soaked in cold water to remove the unaltered bichromate; it is then dried and ironed with a hot iron, in order to harden the coating. After this it is inked, and the ink washed off the unexposed parts in the ordinary way. The picture can then be transferred to zinc for etching.[1]

Considerable progress has recently been made in methods of obtaining grain by means of the natural reticulation of colloid substances, combined with an alkaline chromate, and in the application of such grain, either to photolithography or to the production of surface blocks. Many of the methods employed are, however, of the nature of secret processes. It may fairly be assumed that in most cases the secret

[1] In the *Photographic News* of July 13, 1883, a print is given, the block for which was made by this process. This block, however, does not serve to illustrate the applicability of the process for the translation of half-tone negatives, since it is a copy of a pen-and-ink sketch. It is in fact an ordinary phototype block, by a transfer process, in which starched paper has been used instead of gelatinized paper.

consists of minute variations of the proportions of the ingredients used, or (and more frequently) in manipulative skill. At the same time, it is not to be forgotten that in these small differences lies the difference between success and failure.

The reticulation of the gelatine is present in collotype plates, but generally in an extremely fine form, though sometimes it is very noticeable in the finished print. Even in an ordinary gelatine dry plate it sometimes appears. In the "Year-book of Photography" for 1885, Mr. Borland proposes a process for the production of type blocks founded on this fact. He floods an ordinary gelatine negative with hot water (up to 100° Fah.), and a beautiful reticulation immediately shows itself, bringing the details of the negative into a relief quite sufficient for casting from. The great simplicity of the idea recommends it, and it is very possible that a successful method may hereafter be developed from it.

It does not appear that the Pretsch, or any similar method is at present used directly for

the production of type blocks, but the successful "Ink-Photo" process of Messrs. Sprague seems to be based upon the same principle. Messrs. Sprague have not published their method, which is a lithographic one, but it is evident from the appearance of the pictures that the natural grain of the gelatine film is transferred to the stone. Such a process as this offers great advantages in many cases. A printing surface can be made at very short notice from any good silver print, and the cost of printing the pictures is not heavy. It must be admitted that as works of art such pictures leave a good deal to be desired, and will not compare with good collotypes, but they are at all events fair transcripts from the original photograph, and are quite suitable for book illustrations of a cheap sort. The process is coming rather extensively into use for newspaper illustration, especially for the reproduction of portraits, and as it has already been considerably improved since its first introduction, it will doubtless be still further developed. The quality of the

results in this, as in all similar processes, depends on the special fitness of the negative. It does not follow that the negative which is best for giving a silver print is also best for the purpose of making a type block. Soft delicate negatives full of detail do not appear to reproduce as well as rather hard negatives with strong contrasts of light and shadow.

CHAPTER VIII.

Production of Type-blocks from Half-Tone Negatives (*continued*).

THE devices belonging to the second class, those in which a mechanical stipple, line, or grain is produced on one of the sensitive surfaces employed, have been very numerous. The grain (when one is used) may be produced in the negative, in the positive, or on the film of bichromatized gelatine or its substitute. It may be on a transparent screen, interposed between the transparency, whether negative or positive, and the surface printed upon; or it may be placed in contact with the transparency which is copied in the camera; or it may be produced on the transparency itself, by various means, as by printing lines

or stipple upon it, by dusting powder on it, and by other plans patented and re-patented over and over again. The devices, in fine, by which this end has been sought are innumerable. And the same may be said of the means employed. Some inventors have used gauze or other fine fabric, others ruled lines, others again the natural gelatine grain previously referred to, by printing from a suitably grained surface on to a transparent medium, or even on to the surface of the print to be copied. The favourite plan, and the most successful, is to use a photograph of a suitable grain or network, interposed between the transparency and the surface on which the transparency is to be copied, a film photograph being employed when the printing is to be effected by contact.

In all these processes the great difficulty has been to get a graduated stipple. It is evident that if we expose a negative over a sensitive surface with a network interposed, the picture will be broken up, and further, that in the whites of the picture, as these are already fully protected by the shadows

of the negative, the network will have no effect, and consequently no grain will show. If the exposure takes place under a positive, the reverse action will take place. If the whole surface of the transparency be ruled with lines, or impressed with a grain, these lines, according as they are transparent or opaque, will appear in the lights or in the shades, being merged either in the full shadows, or in the full whites. In either case a certain value will be given to the half-tones, but they will vary as a rule very little from the deep shadows, and there will therefore be a prevailing flatness and insipidity in the picture. To get rid of this flatness, and to infuse vigour into their production, has been the chief aim, and the chief difficulty of inventors of processes for making blocks from half-tone negatives.

The first to attempt to produce a grain by any of these mechanical means appear to have been Bullock and Swan, both of whom patented devices for attaining this end in 1865. Bullock, according to a paper which he read before the Photographic

Society in 1866, tried a number of different devices. The glass plate on which the original negative was taken was grained; the finished negative was coated with granular varnish; the negative was copied in the camera, with a grained plate interposed between it and the camera; grained plates were interposed between the negative and the paper. None of these methods appear to have been very successful, though it is worth notice that several of them contained the germ of success, since some of the best recent processes have been based upon them.

Of the two methods which Mr. Bullock states were most successful, one seems to have gone out of use, but the other has served as the foundation of some recent processes. The first was to imprint a grain, by aquatint or otherwise, upon the unsensitized gelatine paper—all that was required being to sensitize the paper with bichromate of potash, and print from an ordinary negative. The exposed surface was then inked and washed in the ordinary way.

To carry out the second process a piece of ground glass, or a photographic copy on glass of some reticulated surface, was placed face to face with the negative, and a transparency taken from the two whilst in contact. From this transparency any number of negatives could be produced, each containing a granulation so marked as to give the prints on transfer paper a well-marked half-tone composed of lines or dots.

Major Waterhouse [1] gives the following description of Mr. Swan's process:—

"In Mr. Swan's process he first produced what he termed a crayon photograph, *i.e.* one in which gradation of shade was produced by dots of opaque matter more or less aggregated as the shading is darker or lighter, and therefore corresponding to a crayon drawing in the principle on which the gradation of shade is produced. Such a crayon photograph may be produced in various ways, but Mr. Swan preferred to obtain it by means of a gelatine tissue containing a certain proportion of charcoal or other opaque substance, in such a state of division or granulation that when diffused through the gelatine solution and spread upon glass in a thin layer, the

[1] *Photographic News*, 1885, p. 269.

opaque particles will show distinct granularity between particle and particle. This tissue was either prepared ready sensitized with bichromate, or could be sensitized as required. It was exposed under a photographic negative or positive, that surface of the tissue which was uppermost during the solidification of the gelatine being placed next to the cliché, and care being taken that the light might fall at right angles to the plane of the cliché. After exposure the exposed surface of the tissue was coated with a solution of india-rubber and dammar in benzole, and mounted on a glass coated with the same solution, the solvent being allowed to evaporate. The image was then developed in warm water in the usual way. The crayon photograph could also be produced by the dusting process."

The crayon photograph obtained by the above methods was used instead of an ordinary negative or positive for the production of a transfer print in the usual way.

Both these processes were intended for photolithography, though they would be equally available for the production of surface blocks. It does not appear that the process of Mr. Swan has been developed, or that it is now in use. It is certainly a very promising one, and possibly it may

yet be taken up and brought to perfection. For the production of intaglio plates, as will be seen later on, this device of using a granular tissue has been employed with very considerable success.

It has been otherwise with Mr. Bullock's plan, for the method of producing grained negatives by placing a transparent screen, on which a suitable grain is imprinted, in contact with the negative or the positive to be copied, and then photographing the two together, has been brought to great perfection lately, and most, if not all, the successful processes now coming into use are dependent, at all events partially, upon it. Meisenbach, of Munich, took out a patent in 1882,[1] in which the method he employs is described as follows:—

"A transparent plate is hatched or stippled in parallel lines. A transparent positive is made of the object. The two plates are joined, preferably face to face. From the combined plates a definite negative is photographed in the ordinary manner. In order to cross-hatch and break the lines of the shading, the

[1] 8th May, No. 2156.

hatched or stippled plate may be shifted once or more during the production of the said definite negative. This negative is transferred in the usual manner on to a plate of suitable material, which is graved or etched in the usual manner to form a typographic block. For the engraving plates the negative is transformed into a positive, and the latter is transferred on to the etching plate in the usual manner."

The inventor also states that the hatching or stippling may be produced photographically on the same plate as that on which the original object is photographed, and this plate used direct for the production of an "engraved," or intaglio, plate.

It will be seen that not very much information is to be gathered from the patent as to the method of operation, and as the process is worked in secret, it may fairly be assumed that the means by which success has been attained was not divulged in the specification. Nevertheless some work of the very highest character has been done by the company working the process, both in this country and abroad. A large print, from a photograph of Sarah Bernhardt, the celebrated actress, issued as a supplement

to the *Photographic News* in November, 1883,[1] was one of the first illustrations by this process issued in this country, and it left almost nothing to be desired for brilliancy and softness combined. Since that date excellent work from blocks by the same inventor is constantly appearing in the Magazine of Art and other periodicals, and quite lately it has also been used for the illustration of books. The process has even with fair success withstood the severe test of illustrated journalism, for the *Graphic* recently published a supplement, the illustrations of which were Meisenbach blocks, reproducing photographs of animals in the Zoological Gardens. It must be said that the pictures produced by the process have varied much in merit. Some have been extremely good, but others again have been extremely bad. Doubtless a certain amount of this difference may be attributed to printing, but that will not account for all of it.

A process, to all appearance of a closely

[1] *Photographic News*, Nov. 23, 1883.

similar nature, is being worked by Messrs. Goupil, of Paris, who have given it the name of typogravure, and also by Messrs. Waterlow, of London. The last-named firm have produced some excellent blocks, giving a little more vigour and brightness than is usual in blocks from half-tone negatives.

Another device which has been employed to get a grain on to the picture is to print from the original negative, by any suitable process, upon a piece of silk. The threads of the silk break up the picture printed on it into a very nice and regular grain. The positive on the silk is then photographed, and a printing block made by the ordinary etching process. Unfortunately it is found impossible to get silk of a sufficiently even and regular texture for the purpose. Flaws and shadows, not noticeable even in the print, come out with startling distinctness, and the inventor of the process has given it up on this account. Some experimental blocks, for the production of which suitable bits of silk had been found, gave promising

results, but there the idea seems to have been left.

One chief defect of these processes is that they give extremely low relief. A block made by one of them looks more like a copper plate than a genuine surface block. Then (and with low relief it is inevitable) they give little or no pure whites or solid blacks. The range of tones they give is consequently very limited, and the picture is of necessity flat. The earlier Meisenbach blocks had no pure white at all, but they are improving, and in later blocks, by this and other processes, surfaces of clear white are now attainable.

On account of their very low relief, all these blocks require the most delicate and careful printing, but in the hands of an expert printer, they can be made to give excellent results.

In some cases the makers of blocks by these processes prefer to use copper for the fine and delicate work they turn out instead of zinc. In this case the etching fluids used for the original plate-etching process

are available. Of these, one of the best is the mixture of hydrochloric acid, chlorate of potash, and water known as the "Dutch Mordant." Perchloride of iron may also be used. This is said to show but little tendency to undercut the lines, and the first etching may be carried a good deal further than is safe with zinc. When proper printing depth is wanted, it is a very tedious business to obtain it with copper; but in cases where such depth cannot be had at all, there is less disadvantage in using copper, and there is the natural gain of using the stronger and closer metal.[1]

In the same year as that of Meisenbach's patent (1882), Messrs. Brown, Barnes, and Bell, of Liverpool, took out two patents,[2] in which very similar methods are described.

These inventors claim various methods of producing the grained surface. They propose to grain the surface of the photograph

[1] Further information as to the method for typographic engraving on copper will be found in the *Photographic News* for 1883, p. 338.

[2] No. 1380 (amended and reprinted as 1380*), 15th March, 1882, and No. 4705, 3rd October, 1882.

itself by hand, to copy the negative and a photograph of a grained surface simultaneously or successively on the same sensitive surface; to grain the surface mechanically by pressure against a sheet of wire gauze or other suitable material, or by printing a grain upon it; to cover the sensitive plate in the camera with a network, and to copy the original photograph with this network interposed between the plate and the original, or to back up a transparency of the original with paper bearing a grain, and then to photograph.

Some blocks produced by this firm were printed in a local paper, and certainly possessed the interest of illustrating the application of phototype blocks for such a purpose, but in the opinion of most who saw them they rather failed to prove the suitability of the process for such a use. Which of the many devices referred to in the above-quoted patent specifications was used in the manufacture of the blocks, or whether any of them were, does not appear to have been stated.

CHAPTER IX.

Production of Type-blocks from Half-tone Negatives (*continued*).

THE third class of processes mentioned in Chapter VII., in which a stipple is impressed on a Woodbury or other suitable relief, holds out great promise, and has already, in the hands of Mr. Ives, of Philadelphia, given excellent results. The late Mr. Woodbury himself attempted to make type blocks from his reliefs, and succeeded in producing some good work, as indeed so clever a manipulator was likely to do by any process. It is of course evident that a simple relief, whether a Woodbury relief, or a cast in swelled gelatine, obtained by methods already described, would not serve our purpose; the relief from a half-tone

negative would not print, any more than the surface of a medal or a coin would print, and an indistinct and blurred outline would be the best that could be hoped for.

Woodbury broke up the image by placing between the gelatine film and the transparent positive from which the picture was to be taken, a piece of network, either a piece of some suitable fabric, such as gauze, tulle, etc., or a photograph on collodion or mica of any suitable design which would give the stipple required. The effect of this was to give a strong grain in the higher parts of the relief, an absence of grain in the lower parts, and a moderate amount in the intermediate parts. From this grained relief a block was made in soft metal by pressure, and this block could be used for printing if only a small number was required, or if it was to do much work, an electrotype could be made from it in the usual manner. In his patent specification, the inventor refers to the use of diffused light for printing, "As in that case the light in the parts that represent the white creeps round the

lines, thus partly obliterating them in that part, and leaving them strongest only in the parts printing dark." An obvious objection to this method is that the different parts of the printing surface are not in the same plane, and for this reason Mr. Woodbury lately modified the process by taking a transfer from the relief, and laying this down on a zinc plate to be etched. So far as the writer is aware, this process has never been worked commercially, or indeed by anybody but the inventor.[1]

Mr. Ives's process certainly shows more originality than is to be found in most of the recent methods for producing type blocks. His first plan (patented in the United States in 1878) was to take an inked Woodbury relief, and to press it against grained or embossed paper. The higher parts of the relief were forced most strongly against the paper, and consequently crushed

[1] A description of the process is given in Bolas's Cantor Lectures, published in the Society of Arts Journal, vol. xxxii. p. 1090. Fuller details are given in the inventor's Patent Specification, No. 1954, of the year 1873.

down the grain upon it, producing a more or less solid black. The lowest parts of the relief did not touch the paper at all, and consequently left no mark upon it. The intermediate parts touched the points of the paper lightly, and consequently received a little ink, or were slightly flattened down, and therefore took a larger quantity of ink. The stipple was therefore perfectly graduated from solid black, through a coarse grain gradually growing finer, up to pure white. The picture on the grained paper was, in this first process, copied in the camera, or transferred direct to stone or zinc, for the production of an etched block by any of the known methods.

In an improvement on this process, Mr. Ives substituted a swelled gelatine relief for the Woodbury relief, and took a cast from this in plaster. On this plaster cast he impressed lines or stipple by means of an elastic stamp, and this plan, Mr. Ives says, gives the operator considerable control over the effect. By flowing the inked plaster over with collodion, he was able to transfer

the ink to the resulting film, and after stripping this film off, he made a print from it on a dry plate. The last improvement (1884) was to transfer the ink impression to a sheet of india-rubber, and thence to stone or zinc, it having been found that the direct transference from the plaster itself, though practicable, did not give the best results. Ives's blocks have been used to a considerable extent in the illustrated American magazines, and many of them show very great merit.[1]

Some other inventors have been working in the same direction as Ives, but none of them seem to have anticipated him. Eggis proposes[2] to employ carbon paper instead of inking the film; the paper is placed between the relief and the grained paper, but the rest of the process is the same as the earlier one of Ives.

[1] Full information as to the Ives process will be found in the volumes of the *Photographic News* for 1883 and 1884, pp. 498 and 677, of the former, and pp. 130, 257, and 324 of the latter. Also in Bolas's Cantor Lectures, Society of Arts Journal, vol. xxxii. p. 1091.

[2] *Photographic News*, 1883, p. 789. Society of Arts Journal, vol. xxxii. p. 1091.

Zuccato uses a different application of the same principle. In one of the devices proposed a piece of type metal or similar surface planed into a series of ridges, or pyramids, is inked and pressed against the relief, with a piece of very thin paper interposed; the relief crushes down the pyramids in proportion to its depth. The pyramid of type metal is spread out, and forms a sharply-cut outline on the paper, and in this way a transfer is obtained which is said to have a remarkable clearness of outline. In another process he interposes between the relief and a sheet of transfer paper a piece of gauze, or a piece of silk which has been inked with transfer ink; the threads of the gauze get crushed out to a greater or less extent, and form lines of greater or less width; but this method in which the gauze is crushed down is not nearly so perfect as the method with the plate of type metal.[1]

Another device of the same inventor is

[1] Bolas, Cantor Lectures, Society of Arts Journal, vol. xxxii. p. 1092.

to press the relief upon a lithographic or zincographic surface on which an ink stipple has been impressed. The stipple gets crushed out more or less, according to the extent of the pressure; and this depends on the thickness of the relief.

The patents previously referred to, of Messrs. Brown, Barnes, and Bell,[1] also allude to the use of a Woodbury film, grained by one of the methods they describe.

For artistic purposes, all these processes labour under the grave drawback that they can only reproduce the original photograph with its defects, as well as its merits. For portraits this is really less a disadvantage than for landscapes. Our photographic portraitists are now so expert at lighting and posing, that a good photograph is as satisfactory and as artistic a piece of work as a painting by any but one of our greatest artists. Of course a good deal is done by the pencil, working upon the lines first drawn by the sun, but surely this is not a legitimate objection; if the result is good,

[1] See *antè*, p. 161.

that is all that ought to be wanted. Naturally, portrait-painters decry photography; they would not be human if they did not. Many, however, use photography extensively, and many more would be wiser if they used it to a still greater extent. Decry it however as they may, the fact remains that a good photograph is a better portrait than can be produced by any painter outside the number of a select few who can be counted on the fingers almost of one hand. This being so, though of course it is heresy to say it, there ought to be no reason why very satisfactory portraits should not be produced by the use of relief blocks direct from photographs. It is too much to say that any process can do this as yet; but if the advance of the last two or three years be continued, it will not be long before such blocks will take the place of woodcuts in the illustrated periodicals and papers at all events.

With landscape it is different. The photographer cannot control the lighting of the scene as he can that of the figure

in his studio. He cannot lighten up the dense black mass of shade which perhaps spoils the look of his picture. He cannot always get at once his extreme distance and his foreground. He cannot omit some offensive staring object which comes, as such things always do, precisely in the most objectionable of all possible positions.

Hence there will ever be a difficulty in the direct production of printing surfaces from landscape photographs, or rather in producing blocks or plates for printing in line, which will compare favourably with an artist's sketch. Doubtless these difficulties exist in all photographic pictures; but in processes like silver printing or collotype, where the actual tones of nature are reproduced with more or less accuracy, they are not so great as with processes where those tones have to be translated into conventional line and stipple: under these conditions rigid mechanical methods can hardly ever hope for success.

It will, of course, be understood that nobody pretends that pictures produced by

any mechanical process, however ingenious and however true to nature, can ever seriously compete with the work of even a moderately skilful landscape artist, whether painter, etcher, or sketcher. The camera cannot interpret nature. It can at best reproduce. If "what a great landscape painter attempts to render is not the natural landscape, but the state of feeling which the landscape produces in himself,"[1] it is hardly necessary to argue that such interpretation cannot be effected without the intervention of the artist's mind.

Were it possible to realize the old magician's dream, and fix for ever the image of a landscape as it is seen in a mirror, that would not suffice. How much less, therefore, any method of rendering permanent the changes effected by light and shadow falling on a surface sensitive to those changes. Except for the sake of avoiding misapprehension, it is scarcely worth while even to state this. For such sake, however, let it be said, and said once for all,

[1] Hamerton, Etchers and Etching, ed. 1876, p. 66.

that as all our methods are essentially mechanical, their highest aim is faithful reproduction; that their merits are greater or less in proportion as they approach this standard; and that if they are spoken of as artistic, it is within the reasonable limits enforced by the unchanging character of the conditions.

Working within these limits the landscape photographer can, by judicious selection of his subject and by skilful adaptation of the means at his command, produce pictures of very high merit. For beauty of appearance no photographic process has yet equalled the silver print, and in proportion as other processes, free from its drawbacks, approach the merit of the silver print, so may they be estimated.

Photography, on the other hand, has the very great and important advantage that all modifications and interpretations on the part of the artist being impossible, pictures produced by it of necessity possess an absolute and unquestionable fidelity to nature. Where it is important to reproduce

accurately any natural object, the use of the camera is a guarantee of accuracy. In the case, for instance, of a traveller's descriptions of a new or little-known country, photographs reproduced without the intervention of the draughtsman afford invaluable evidence of the truth of those descriptions. In all works of a scientific character such unimpeachable evidence is well worth the sacrifice of some artistic merit.

This is fully recognized by scientific men, who will now hardly recognize as evidence a drawing whenever a photograph is possible. Thus, for instance, Mr. Norman Lockyer referred to a photograph of the Nebula of Orion, taken after much labour by Mr. A. A. Common, as being worth more for scientific purposes than all the numerous drawings which had been made of the same object in all the years during which it had been observed.

But unless the actual photograph can be reproduced without the intervention of the draughtsman, or of the wood-engraver, half this advantage is lost. Hence even a bad

reproduction, so long as it shows the form and whatever characteristics of the original are required to be shown, is better for many scientific purposes than a more artistic and attractive woodcut. There is now every reason to expect that wherever it is of importance to reproduce accurately the original photograph as an illustration in the text, that will soon become a regular practice, drawing being as now resorted to in the very numerous cases in which a satisfactory illustration cannot be obtained by photography. As the artist chooses out those points which lend beauty to his sketch, and gives them prominence, so he whose duty it is to explain any scientific fact must often find it necessary to omit many details which may conceal or obscure the points to which he desires to draw attention. In the preparation of such pictures, the camera, which has no selective power, and can only reproduce all that is in front of it, will often lend little or no aid.

When, however, a natural object has to be represented, it is not easy to over-

estimate the importance of obtaining that representation by the unerring process of photography, whenever it is possible. With the best intentions, draughtsmen cannot always be accurate. They have no special knowledge of the subject to be illustrated, they may omit important characteristics, and they may unintentionally falsify others equally important. Of course, photographs may be deceptive, and they can be purposely sophisticated, but such alteration is generally capable of detection and only occasionally possible. In all cases where accuracy of representation is essential, illustrations ought to be made by some process of the nature of those dealt with in these chapters, so that the block from which the picture is printed can be made direct from a negative of the object itself.

In the reproduction of pictures or of sketches specially made for such reproduction, there is a great future for typographic blocks, as there is for similar blocks from line-drawings, or for photogravure methods for the production of large engravings.

The illustrations issued with the French publication, *Figaro-Salon*, edited by Mons. A. Wolff, show what can already be done in the direct reproduction of pictures, for all these illustrations are from relief blocks, and are printed with the type. It may be safely assumed that a good deal of hand work has been expended on these blocks—which are made on plates of copper, not on zinc plates; but even if this is so, that amount of hand work is as nothing as compared with the skilled labour required for the cutting of a wood block, even when the draughtsman's work is economized by photographing the original upon the block. There seems reason to believe that if blocks of this character can be readily produced, and easily printed, they will run the engraving methods hard for all work except the very finest.

But the special value that these processes have is that they enable an artist to execute his sketches in monochrome, and to get them copied direct, the intermediate process of drawing being rendered unnecessary.

This is of very great advantage in many cases. Not only does it save much time and labour, but it may give the artist the power of expressing himself in the medium that suits him best, and allow him consequently greater freedom.

Special precautions are necessary in preparing sketches for copying by photography. Not only do the rules laid down for line-drawings hold good, but certain additional points have to be considered when washes of colour are employed. To begin with, yellow tints must be avoided; they will of course give a much darker tone in the photograph than in the original. Blues, on the other hand, appear lighter. It is particularly important to avoid the use of yellow and blue tints in the same picture. The effect may be correct to the eye, but it will be entirely falsified in the photograph.

The best colours to use are Chinese white and lamp-black. A little gamboge may with advantage be added to the black, as it will insure more vigorous blacks in the photograph. An artist who

has had much experience in work of this sort told the writer that he found it convenient to mix up a pot of his black with a little white in it, and to use this for his strongest shadows, adding white as he required for the intermediate shades. He had then his full black in reserve, so that a few touches could be added as required to the nearly finished picture.

By confining himself to pure blacks and greys, the artist will be enabled to judge with accuracy the effect which will be produced in the photograph, but he is likely to be wofully misled if he uses tints with a shade of colour, especially if such tints are laid over others.

In this country we are certainly behind our rivals on the continent, both in France and Germany, as regards the use made by publishers of the facilities now afforded by modern reproductive processes. As an instance of the enterprise of French publishers may be mentioned a large work now being issued by the successors to Messrs. Goupil, of Paris, which contains reproductions of

pictures illustrating the Franco-German war, by Neuville, the popular French painter of battle pieces. This work, which has either recently appeared, or is in actual course of publication, is or was issued in parts of large folio size, each part containing a number —six or eight—of whole or half-page illustrations, and often a double-page picture in addition, the price of each number being two francs. The printing and paper leave something to be wished for, and the subjects of the pictures will not interest everybody; but as reproductions they are extremely good, and as evidence of how cheaply, and with what uniform excellence, work of very high character can be produced, they are most remarkable.

Nothing of the sort, so far as the writer is aware, has ever been attempted in this country. Why this is so, it is not easy to say. It is hard to have to admit that our printers are so much inferior to those of France that such work cannot be done in London; but if lack of capacity cannot be pleaded as an excuse, the only

reason seems to be want of enterprise. The printing of the publication above mentioned has certainly not been executed with very special care; the type on the back of the page is often visible through the paper, quite spoiling the impression, and the whole thing is evidently a cheap publication; still, there it is—a cheap book, full of excellent pictures, pictures doubtless suited to the popular taste, produced by means which a few years ago were not in existence. To issue a book of this sort is a credit to its publishers, and to neglect so important a means of cheapening the production of good illustrated books, without in any way lowering their merits, is very little to the credit of our English firms.

And in Germany, too, the case is the same. Not only is better work produced by phototypic methods, but far more use is made of those methods. Possibly one state of things may be the cause of the other; anyhow, there are not likely to be many to dispute the fact. In England one meets now and again with a new book in

which a few "process" blocks have been used. In Germany a large proportion of the illustrated books contain pictures from such blocks. Were it not for the enormous stores of old *clichés* which, like newspaper paragraphs, seem to go the round of all the countries in which books are manufactured, returning every now and again to the land which gave them birth, probably the use of phototype blocks would be even larger still; but as it is, a very large proportion of the new pictures in German books seem to be thus produced; and as the proportion seems to be rapidly increasing, it will doubtless be a good deal larger in the course of a short time.

CHAPTER X.

Photographic Methods of Producing Intaglio Plates.

IT is not difficult to see that almost any of the processes used to produce phototype blocks from line subjects might also be applied to the production of intaglio plates which could be printed from in the same manner as copper plates. The only necessity is to arrange that the etching should, as in ordinary plate etching, attack the metal in the lines of the picture, not in the whites. The photograph must therefore show the lines dark, and the whites must be represented by clear glass, that is to say, it must be a positive. If a copper plate be coated, say, with a bituminous varnish, and exposed behind such

a positive, the lines will be left unaffected by the light, and the varnish covering the metal can be dissolved off by the usual solvents. A slight etching in any suitable etching fluid will incise the lines. The process is a more simple one than that of etching a block, as the relief required is so much less, and the precautions of inking up, re-etching and resining are not required; the process, in fact, is the same as that of etching a copper plate on which a design has been drawn on an etching ground.

It is only for certain purposes that processes for producing intaglio plates photographically from line-engravings or drawings in line can compete with photolithographic processes on the one hand, and processes for making surface blocks on the other. Photolithography is a great deal cheaper and a great deal faster; surface printing is cheaper and faster still.

But, by treating a plate thus prepared with the same care as is bestowed upon an original etching, biting in different parts of

the plate to different depths so as to enable some of the lines to hold, and therefore to transfer to the paper a larger amount of ink than the others, by adding hand work where required, employing in fact a large share of the skill which goes to the production of a good copper plate, or a good etching, much finer results can be obtained than either of the above-named methods will give.

The principal application of this method has been to the reproduction of the works of the older engravers. So successfully has this been done, that such copies, when carefully printed upon a suitable old paper, have been declared by so good a judge as Mr. Reid, the accomplished Keeper of Prints at the British Museum, to be so similar to the originals that it was almost impossible to distinguish between the original and the copy.[1]

Another application of these particular processes is the reproduction of the original

[1] Comyns Carr, Cantor Lectures on Book Illustration, Society of Arts Journal, vol. xxx. p. 1056.

illustrations for a reprint of a book, and here again considerable success has often been attained. For the reproduction of large originals, such as the ancient views of London by Wyngaerde, and by Visscher, published by the Topographical Society, the process is very suitable, as the plates are too large for convenient printing at press, and the results might probably not have been quite so good if they had been produced by a lithographic process. Original sketches have been reproduced by photo-intaglio plates, but, as the writer believes, not to any great extent, and it must be doubtful whether, considering the cost and slowness of the printing process—the plate, like any other copper plate, has, after each impression, to be carefully cleaned, inked, wiped, and again partly cleaned—it can often be worth while to adopt this method of producing pictures.

On the whole the opinion may safely be expressed that at present there seems no great reason to expect any great development in these processes. Those who are

working at the subject are all turning their attention in other directions, where there is better promise of satisfactory result.

The production of engraved plates direct from paintings or sketches in tints, by what is known as heliogravure or photogravure, is of course a very different matter. To the solution of this problem much time and a great deal of ingenuity has been devoted, nor has the success achieved been slight. Of recent years very great advance has been made, and quite lately results have been shown by several different printers which appear to hold out the probability that the work of the copper-plate engraver may soon be superseded, at all events so far as relates to the reproduction of the work of others. The processes by which these results have been effected will, so far as they are public property, be considered in the following chapter. For the present we are concerned merely with the production of intaglio plates from line subjects alone.

Any of the heliogravure processes are available, and many of them are used, for

the reproduction of line drawings, and they have all the advantage that by the introduction of a grain they give a better hold for the ink than when the grain is absent. The ink is apt to be wiped out of the lines when these are thick, and have been produced by a process which gives a smooth surface all over the copper: which metal, it should be said, is used almost exclusively for this class of work. There are, however, a few processes which have been devised specially for the production of intaglio plates from line subjects, and these may be briefly noticed.

The original bitumen process of Niepce de St. Victor has already been referred to.[1] This was originally brought out as a method for producing plates, not blocks, as indeed were all the earlier processes.

An electro-deposition process has been worked with a considerable measure of success by Messrs. Dawson. A carbon print is developed on a metal plate, it is then blackleaded, to give the whole a conducting

[1] See *antè*, p. 107.

surface, and copper is deposited upon it. The carbon print is of course in slight relief, and the electrotype from it is consequently a not very deep intaglio. How far the process is worked in this form the writer is not aware, but there is no doubt that experimenters with the process—and these have been numerous—have generally found that more satisfactory results are obtained when some device is employed to give a grain or tooth to the lines. This, however, greatly depends upon the character of the work, and doubtless for fine line-work the simple method described is quite sufficient.

Ehrard's process, described by Captain Abney,[1] is worth mention, because it depends on different principles to any yet noticed. A copper plate carrying on it a transfer of the usual character is treated in an electro-silvering bath. The copper, where it is not protected by the lines of the transfer, is thinly coated with silver, the metal under the lines of greasy ink remaining unaffected.

[1] Treatise on Photography (1878), p. 183.

By treatment in a solution of chloride of mercury, the silver is converted into a double chloride of silver and mercury. The ink is then removed and the plate etched. The chloride film protects the metal below it, and the acid acts only on the copper where it is not covered by the chloride.

Another interesting point about this process is that it closely resembles an early process by which Sir William Grove successfully converted daguerreotype plates into plates capable of being printed from. The daguerreotype image is formed of a white amalgam of silver and mercury on a ground of silver, faintly gilded. The plate in a solution of hydrochloric acid was subjected to an electric current from a battery, when an oxy-chloride of silver was formed. On its removal it was found that the plate had been bitten sufficiently for printing purposes.[1]

[1] Abney, Treatise on Photography, p. 42.

CHAPTER XI.

Photogravure.

THE processes to which the general names of Photogravure or Heliogravure have been given, those, to say, which are used for the production of intaglio plates from half-tone negatives, have been up to the present a good deal more extensively used than the corresponding processes for the production of relief blocks; in fact the publication of engravings from pictures printed from Photogravure plates has been carried on commercially for some years. There are various reasons for this. First, the plates are really made by a combination of mechanical processes and hand work. The plate, after being carried as far as possible by the process, whatever it

may be, is then handed over to an engraver, who takes up the work where it was left, and renders the plate fit for printing. That this is possible arises from the similarity, both of material and method. If, say, a plate etched by any of the methods employed in photogravure be handed over to an etcher, he might perhaps have a good deal to do to it in the way of correction and alteration, before it would give a passable print, but it would be merely carrying on the same process of biting away parts of the plate by means of acid. If, on the other hand, an etched zinc relief block were given to a wood-engraver to finish and perfect, he could do nothing, or next to nothing, to it. Thus, however imperfect the actual results of the process may be in themselves, if they afford a basis on which the engraver can work, if they act as a substitute for any part of his work, the process can be employed. This, as a matter of fact, they have done for some time. By the use of photogravure the time necessary for the production of a copper plate has been

reduced from years, at all events to months, and the cost has been lessened in corresponding proportion. The principal workers of photogravure do not publish the methods they employ, but it is generally understood that the admirable pictures they issue are partly produced by photographic means, and partly by handwork, either etching or engraving.

Recent developments of photographic methods have considerably lessened the amount of handwork necessary for the production of a good printing plate, and some fine pictures have been exhibited on which there was stated to be no handwork at all; but it can only be in rare cases that perfect results are to be obtained without such aid: and though the amount of it may be lessened, it is certain that some must always, or nearly always, be employed. As a *tour de force* it may be interesting to see the amount of success that can be attained by purely automatic methods—methods not dependent simply on the skill and ability of the worker; but when it is a question of

obtaining a certain result, the only points that ought to be considered are the merits of the result and the facility with which it has been gained. If the best picture can be printed from a plate made partly by photographic, partly by chemical means, and finished with the graver, the means adopted to produce that plate will come, and ought to come, into general use.

The principal use of photogravure is for the copying of large pictures, and for this purpose it is likely to continue to be used to an increasing extent. One great difficulty, indeed the greatest difficulty, in using photography for the reproduction of pictures arises from the fact that the scale of tones in which colours are reproduced by no means corresponds with their relative brightness to the human eye, or therefore to the tones of light and shadow by which we naturally represent colours when we attempt to give their effect by black and white. If we look at the prismatic spectrum, the brightest part of it is that which consists of the yellow; but if we photograph the

same spectrum, we shall find that the yellow portion has hardly affected the sensitive salts of silver at all, and in the print from our negative we shall find the yellow space represented by a dark shadow, while the blue and violet parts, which to the eye appear comparatively dark, will act vigorously on the photographic surface, and in the corresponding positive they are represented by white.

Still all the rays of the spectrum affect a photographic surface more or less; and if time be given, photographs can be taken even by the yellow or red light.[1]

If therefore the action of the more photographically active rays can be delayed, so as to give the feebler rays time to work, this inequality of action can be removed, or rather minimized, and it is found that by

[1] By this of course it is not meant that a portrait could be taken in a room glazed with red glass, but that the red end of the spectrum has been photographed, and that, as some amateur photographers have found to their cost, it is perfectly easy to print a transparency by the light which passes through the red window of many a so-called dark room.

staining the material of which the sensitive plate is composed, or, to speak more accurately, the medium in which the sensitive salt is held, with a stain of reddish or yellowish hue, this effect is produced. The more active rays are delayed, and consequently their effect is lessened. The feebler rays pass on unhindered, and so their comparative power is increased. Similar effects are produced by the interposition of a coloured screen between the photographic lens and the object, or between the source of light and the object, which thus becomes illuminated with coloured light. It is therefore now becoming the practice for photographers copying pictures to employ either a gelatine plate stained with eosine or other suitable dye, or when they prefer the wet-plate process, to make use of a collodion similarly coloured. Sometimes the coloured screens are used as well, sometimes not, the practice of different photographers varying in this respect.

The production by etching of an intaglio plate is naturally a simpler process than

that of a relief block. There is less depth to be obtained, and in the shallow lines required there is no risk of the acid undercutting the edges. So also is the production of grain easier, since it is only required that the surfaces of the etched portions should be roughened sufficiently to hold the ink when the plate is wiped, for them to possess a certain printing value. It is therefore not difficult to see why the earlier inventors of photographic printing processes endeavoured to produce plates, instead of surface blocks, and also why the former have also preceded the latter in coming into practical use.

In theory any of the processes available for the production of relief blocks would be available also for the production of intaglio plates; since it is only necessary to cause the acid to etch away the lines, as in the old plate-etching process, instead of directing its action upon the parts representing the whites of the picture, as has to be done when we desire a relief block. To effect this it is obviously only necessary to reverse the

lights and shades in the surface forming the protective coating for the plate, bichromated gelatine, bitumen, or other suitable material, and this is most readily done by exposing under a positive photograph, instead of under a negative. In practice several of the etching processes already described are available, with this modification, for the production of intaglio plates, and some also of those described in this chapter will serve for the production of relief blocks, but it has seemed more convenient on the whole to describe here the processes most suitable for engraved plates, as it was in the former chapter to deal with those generally employed in making blocks which could be printed with type.

The earliest process for the production of etched copper plates from half-tone negatives was that of Talbot. He covered a polished copper plate with a weak solution of bichromatized gelatine. This, when dry, was exposed under a positive, so that the shadows of the picture were represented by the soluble portions of the gelatine,

the depth of the insolubility of course corresponding inversely with the depth of the shadow. The plate was then put into an etching fluid, which could act through the soluble portions of the gelatine, but had no effect on the gelatine itself. A suitable solution for the purpose was found to be perchloride of iron, the usual acids employed for etching being of course unsuitable, in consequence of their destructive action upon the gelatine.

It was found that the perchloride acted more or less vigorously, according to the insolubility of the film. The portions of the plate covered with the thickest layer of the insoluble gelatine were left untouched, and those where the gelatine was entirely soluble were most deeply etched. When the etching had gone far enough, it was only necessary to clean off the gelatine, when the plate was ready for printing, the process of etching having roughened the slight hollows sufficiently to hold the ink when the plate was wiped in the usual manner.

Processes based on the principle of Talbot's process, etching through the soluble parts of the bichromatized film, are still employed. As in that process, it is of course necessary to use an etching fluid which will attack the copper without injuring the thin protective film. In the modern modifications of the process it is usual to impart a grain to the plate by one of the methods described in previous chapters,[1] as applied to the production of type-blocks.

The process invented by Klic, and now being worked with great success by Messrs. Annan, of Glasgow, is not at all unlike the original one of Talbot. It is shortly and clearly described in the following extract from the *Photographic News* :—

"The process itself was a secret at first, but we are informed that the principle of working is as follows :—A copper plate is dusted with powdered asphalt, and the plate is heated, so that the asphalt becomes nearly melted. A negative carbon print is now transferred on to the copper plate, and the plate,

[1] See *antè*, Chapters VII., VIII., and IX., pp. 132 *et seq.*

now covered with the negative in carbon, is etched, at first by a strong solution of perchloride of iron, which penetrates only the thinnest parts of the picture; then by a weaker solution of the same salt, the solution etching through the thicker parts. By employing more and more diluted solutions, it is possible to etch through thicker and thicker layers of gelatine, so that only the high-lights remain unetched."[1]

This device of graining the plate by covering it with asphalt dust has been employed in connexion with other processes, and has been found very effective. For typographic work it appears to give too fine a grain.

The method of Klic has been employed to some extent for book illustration, and the writer was shown a short time ago a very elaborate volume issued by a German publisher, all the illustrations of which were thus produced.[2] Many of the pictures were on the same pages as the text, being of course printed by a second operation, not simultaneously with the type. They had

[1] *Photographic News*, 1884, p. 67.

[2] Leben eines Tauchenichts. Published by C. F. Amelang, Leipsic.

evidently been reproduced from originals specially prepared, probably in monochrome. Some of them were extremely good, and all were of fair excellence, quite fit to compare with the average of good woodcuts or engravings that might be expected in a book of the class—an ornamental drawing-room-table sort of book. The style of illustration, the introduction of copper-plates among printed text, is not one to be recommended, but the book showed that its German publisher was at all events alive to the opportunities offered by photogravure, and gave another illustration of the great readiness shown, as was previously mentioned, by foreign publishers to adopt novel methods.

Another of the earliest methods of photogravure was the invention of Mr. Woodbury, and this is believed to be the method which has been for some time worked with very great success by Messrs. Goupil and Co., of Paris. Mr. Woodbury incorporated with the gelatine used in making the relief crushed glass or some similar powder. From the rough relief a leaden reverse was

taken in the manner in which Woodbury moulds are produced,[1] and from this leaden reverse a printing plate was produced by a double electrotyping.

It has always been understood that plates produced by this process require a very large amount of handwork before any use can be made of them. These finishing touches can either be put on by hand with a graver, or by etching, the plate being coated in the usual manner with an etching ground. In some cases tints can be drawn by a ruling machine on the plate, which has been previously covered with an etching ground, or they can be transferred to the plate, and then etched-in in the manner that phototype transfers are usually etched upon zinc. A good deal can also be done by "re-biting" in parts of the plate, which are skilfully inked over with a dabber. In fact, there are numerous "dodges" which a skilful manipulator will employ, and in consequence the finished plate may really have had to pass through a considerable number

[1] See *antè*, p. 39.

of different processes applied to one part or another of its surface. The result of course is that plates produced in this manner are still very expensive, though their cost does not at all compare with the cost of original copper plates. One great objection to such plates is that the grain throughout is entirely uniform, and the resulting prints are consequently very flat, and wanting in vigour, at all events until they have been worked upon by hand.

In 1880 Lieut.-Colonel Waterhouse published[1] a method of obtaining what he termed a "discriminating grain," that is to say, a grain which was closer in the shadows than in the high lights. This was effected by sifting over a Woodbury film, or a carbon print, developed on a copper plate (the copper being, in order that the picture might show up better, generally silvered) some granular powder which had been waxed. Graining sand, emery powder, and powdered glass were all effectual, but the

[1] *Photographic News* (1880, p. 568) and *Photographic Journal*, vol. v. p. 20.

sand proved the best. The coating of wax was given to the particles of sand by stirring up wax and sand together in an iron vessel over a stove, stirring being continued until the mixture was cold. As soon as the relief was dry, the sand was dusted off or washed out, when it was found that the little pits produced by it were deeper in the thick portions of the relief—that is to say the shadows—and shallower in the thinner parts. Of course, where the bare metal was exposed, no sand had adhered, and the surface was left entirely smooth. The plate thus prepared was black-leaded, and an electrotype taken in the usual manner. This electrotype formed the printing surface required.

Very fair results were produced by this process, but it was found to be rather uncertain in its action. It was difficult to get entirely rid of the sand, and small non-conducting particles were thus left in the film. These formed either pin holes in the finished plate, or nuclei from which streaks and markings spread in the process

of electrotyping. A variation in the process was introduced by Mr. Sawyer, of the Autotype Co., and was described by him in a paper read before the Photographic Society in November, 1885.[1] Mr. Sawyer prepared a tissue of the same character as that ordinarily used for carbon printing, but substituted granular plumbago for the pigment. The result of this was that the tissue itself became a conducting material for electricity, while the granulated effect of the Waterhouse process was preserved. An electrotype from a surface prepared in this manner forms a printing surface of an excellent character, though of course it requires a certain amount of touching up by hand before it is ready for the printing press.

Another process is that of Geymet, who relied upon the natural reticulation of the gelatine for obtaining the grain. In this case a carbon print was developed in such a manner as to give strong reticulation, for which purpose Lieut.-Colonel Waterhouse

[1] See *Photographic Journal*, vol. x. p. 28.

recommends treatment with an alcoholic solution of tannin. A relief thus produced was plumbagoed, and a printing plate produced from it by electrotyping. According to Lieut.-Colonel Waterhouse, who worked a good deal at this process with moderate success, the grain given by it was not quite what was required, because, though it is stronger in the shadows than in the lights, and breaks the image well up, it has the disadvantage of destroying the relief, and giving a flat toneless print.[1]

A process of a very original character, quite unlike any other, is that of Obernetter. Its results are highly spoken of by a writer in the *Photographic News*,[2] who also gives a description. A positive transparency is made by ordinary photographic methods

[1] While these pages were passing through the press, Mr. E. W. Foxlee showed the author some very remarkable examples of work produced by a new intaglio process, the details of which have not yet been published. The depth and vigour of the blacks is a special feature of Mr. Foxlee's process, which is an etching one.

[2] *Photographic News*, 1884, p. 67.

on a gelatine dry plate, which ought to be very rich in silver. The film is stripped and treated with a mixture of perchloride of iron and chromic acid, so as to convert all the silver in the film into chloride. The film thus charged with chloride of silver is placed in contact with a copper plate, and a chemical action is set up which etches away the plate. The writer in the *News* suggests other means for converting the silver into chloride, and confirms Herr Obernetter's results from his own experiments. The energy of the action is, he says, increased by moistening the film with a weak solution of chloride of zinc. It may be added that to get good results a battery current appears to be almost essential. One pole of the battery is connected to the plate to be etched, and the other pole to a metal plate separated by some moist porous material from the copper plate.

This process—to which Obernetter has given the characteristically German name "Lichtkupferdruck"—renders half-tones in a fairly satisfactory manner, and gives

a plate which, after a little retouching, is highly satisfactory. The grain is extremely fine in general, but by using an emulsion specially made with a coarse silver bromide it is possible to control the grain very completely.

As regards our special subject, the illustration of books, the intaglio plate is of less importance than the surface block. The special application of all the photogravure processes will be the reproduction, generally on a large scale, of pictures. For this purpose they have special values of their own:

"Engraving on copper or steel, even in the hands of the most skilful exponents, does not aim at any minute imitation of the painter's handling. It has always been regarded rather as a translation than a reproduction, and its exercise has been determined by special laws and traditions, which may be said to constitute a recognized convention of style. In the first place, it is to be noted that, save in the case of mezzotint, all engraving is executed by means of line, and this fact serves, in itself, to distinguish the reproduction from the original, and to make the spectator sensible that the artist's invention has been translated into another language. And even in the finest examples of mezzotint, which so successfully

preserve for us the masterpieces of Reynolds and Gainsborough, there is no attempt to suggest the actual appearances of the picture. The necessities of translation are still frankly and clearly acknowledged, and although the subtle modulation of tone comes nearer to the effect of painting than anything that can be produced in line, the result nevertheless ranks as the product of a separate art, which leaves room for the assertion of the engraver's individual style. But with these mechanical processes, based upon photography, this is no longer the case. It is the picture itself that is transferred to the plate, shorn only of the grace and attraction of colour."[1]

As much cannot as yet be said of any process which will give a relief block from a painting, and until sufficient advance has been made to bring the artistic qualities of the block to a level with those of the plate, the latter will still claim its place among the resources of the illustrators of books, certainly of books the illustrations of which consist wholly or in part of copies of works of art. The power of etching to different depths, and consequently of giving different

[1] Cantor Lectures on "Book Illustration," by J. Comyns Carr, Journal of the Society of Arts, vol. xxx. p. 1058.

values to his lines, remains in the hands of the artist working on a photogravure plate, and enables him to keep his advantage over the wood engraver, or the maker of printing surfaces akin to wood blocks, and therefore we may expect to see photogravure continue to be used for the production of copies of pictures which will be employed for book illustration, as well as for larger work.

Reference has already been made to the use of intaglio plates produced by Klic's method, for book illustration, by inserting the prints into the text. Possibly publishers may occasionally find it worth their while to follow the example thus set; but for the most part pictures produced by photogravure will only take the place of copper-plate engravings, and these, except for the reproduction of paintings, are now but little used.

For the production of large plates, either direct from original pictures, or from monochrome sketches specially prepared by the artist himself or by another hand, photogravure is already largely employed, and its use is rapidly extending.

CHAPTER XII.

Mechanical Processes.

ALL the processes which have been hitherto described have been of a chemical nature, and most of them have depended upon photography. Many inventors, however, have attempted to produce printing blocks by purely mechanical means, and these also deserve a short notice.

Some twenty years ago a good deal of attention was attracted by the Graphotype process, but it has long since fallen out of use, having been entirely superseded by the etching and other recent methods. Still, it was sufficiently original and ingenious in its idea to make it deserving of record. In it, the drawing was made in an ink consisting

of glue and lampblack upon a block prepared by compressing precipitated chalk into a solid cake; in order to prevent the ink from spreading, the surface was rendered non-absorbent by size. After the drawing was finished, the interspaces between the lines were cleared out by a brush, the lines themselves, and the chalk below them, being held together by the ink and so preserved from disintegration. The result therefore was that a block was produced with the lines standing up in relief. This block was then treated with silicate of potash to harden it, and it was thus converted into a compact mass of artificial stone.

It was at first thought that the chalk blocks themselves might be used for printing from; but it was found they would not stand the necessary amount of pressure, and consequently it was necessary to take either stereotypes or electrotypes from them. Rough as the process appears in the description, it was yet capable of turning out very fine work, much finer indeed than would readily be believed. In 1865 or

1866 an edition of Watts's Hymns, illustrated by the graphotype process, was published in order to show the capabilities of the process. The illustrations for this book were drawn by Holman Hunt, Du Maurier, Marcus Stone, Florence Claxton, and other well-known artists, several of whom expressed at the time their appreciation of the process. It is of course impossible to say how much after-treatment the blocks received, but the work is certainly of a very high order, quite as good as we should expect to get from any process. It is to be remembered indeed that these pictures were specially got up to show the very best that the process would do, and the ordinary commercial work sent out by the Graphotype Company was of a very different sort.

An illustrated paper was also published for some time, the illustrations in which were produced by the graphotype process, and they were not specially good. Still for cheap work the process had many advantages, and very possibly, but for the improvements which were introduced into

the etching method, especially the device of protecting the sides of the lines, and thereby preventing their under-cutting by the acid, graphotype would have been continued in use.

Those who are curious for further information on the subject may consult a paper in the Society of Arts *Journal* of the 8th December, 1865, by Mr. Henry Fitzcook, in which a very full description of the process is given. Some cuts printed in the Journal give a good idea of the suitability of the process for ordinary newspaper work.

A process by which a great deal of excellent work is now being done is that of Messrs. Dawson, to which the inventors have given the not very happy name of "Typographic Etching." This is very ingenious, and differs entirely from any of the processes previously described. The design is drawn with an etching needle of special form on a brass plate covered with a wax etching ground, in the same manner as for an ordinary etching. The metal is therefore bared at the lines, which are

separated by ridges and spaces of wax. These spaces of wax are then reinforced by the addition of further material, melted wax being run upon them by the use of a heated metal tool or pencil which supplies a thin continuous stream of melted wax to the parts where it is required. It is found that the force of cohesion in the wax is sufficient to prevent its running over on to the lines themselves and filling them up, as might have been expected. Instead of this being the case, the lines are left perfectly sharp and clear, the freshly added wax combining with the cold wax on the plate, and running up to the edges of the lines. The additions are continued until the spaces between the lines (which represent the whites of the finished print) have been raised to a height sufficient to give the necessary relief, when an electrotype is taken. This electrotype forms the printing surface.

For outline work, and for work of a diagrammatic character, the process is admirably suited, and finished drawings of an elaborate character can also be converted into blocks

by its aid. In this case the original drawing is best made by the artist himself on the prepared plate, and those who are familiar with the use of the etching needle appear not to find any difficulty in drawing on Messrs. Dawson's plates. When this is not done, the sketch has to be copied, a process which is assisted by making a pencil tracing and transferring it by pressure to the wax surface. The process has the drawback that it is not possible to take a proof, except by the roundabout method of photographing the drawing on the plate, or to make any corrections. Neither is it quite so rapid as the etching method, the necessity for electrotyping standing in the way of great speed. It is, however, a serious competitor with those methods, the blocks it produces are of the highest possible character, and suited for any sort of printing, and the many advantages of the process have brought it into somewhat extensive use.

It will be understood from the description that the process is quite capable of producing any picture that can be engraved

upon wood, provided that the artist is sufficiently skilful. Artists, however, are not apt to adopt new methods, and few seem willing to go through the little training which would be required to make them proficient in sketching on the prepared surface with the special etching needle employed. The inventors therefore prefer to reproduce elaborate work by the process described in Chapter VI.[1] Some artists who have adopted the process have produced satisfactory work by it, and they have had the advantage that they can use fine line with greater freedom than in woodcuts, so that their work possessed much of the freedom and the general appearance of an etching or a pen-and-ink sketch.

When maps or diagrams are to be produced, the lettering is done by stamping type upon the wax plate after the drawing is completed and before the "building up" stage, the plate being for the purpose warmed just sufficiently to render the wax plastic. This is a special advantage when

[1] See *antè*, p. 122.

plans, etc., have to be considerably reduced. In that case, as was before mentioned,[1] the lettering is generally reduced to too small a size. The effect too is very neat.

As regards the applications of the process, it may be considered as standing on a par with the etching process as applied to work not requiring photographic reproduction. It is free from the drawbacks mentioned as inherent to the transfer process, but in many cases its inability to show a proof before the block is made is very inconvenient.

Without in any degree reflecting on the merit or the originality of this invention, it is interesting to point out that it has a predecessor, though an unsuccessful predecessor, in the "glyphographic" process, invented and patented some forty years ago by Edward Palmer. In this a plate of blackened copper was coated with wax, and the design traced thereon with an etching needle. Additional relief was gained by painting on a solution of wax dissolved in turpentine over the highest lights. An electrotype was

[1] See *antè*, p. 73.

taken from the plate thus formed, and served as a printing block. The process never came into practical use, either from its cost, or from its results not being sufficiently good. It ruined its inventor, who gave up a good business as an optician to attend to it, and shortly afterwards found himself in the Bankruptcy Court.[1] There is not perhaps any special interest attaching to Palmer's process beyond other unsuccessful attempts to supersede wood-engraving, except from the fact that the same idea has been developed into the very excellent process of Dawson, above described.

The inventions for the purpose of copying, or producing printing surfaces by the

[1] Palmer's two Patent Specifications (No. 8987, 1841, and No. 9227, 1842) do not give details of the method of drawing, which he does not seem to consider important. He published a pamphlet on the subject in 1843, a copy of which is in the Library of the Royal Institution. It is not in the British Museum Library. A short account of the process will be found in a paper on "Engraving and other reproductive Art Processes," contributed by the late S. T. Davenport to the *Journal of the Society of Arts*, vol. xiii. (1865), p. 136.

aid of pure mechanism, do not appear to have been very numerous. Machines are used for the purpose of ruling lines in engraving, to save the labour of cutting them, and reference has already been made to the use of similar lines on paper to be afterwards drawn upon,[1] but these are of a different character. A device by which engraved plates, capable of being printed from, were produced from small objects in low relief, such as coins or medals, is described in Bergeron's *Manuel du Tourneur* (1792), and a practical machine for the purpose was invented by Saxton about 1830. In 1832 also one on a similar principle was patented by Bate, and these have had several successors.[2]

In Saxton's machine, which is quite a

[1] See *antè*, p. 76.

[2] M. De Lostalot, in his "Procédés de la gravure," Paris, 1885, p. 147, gives an illustration of the work produced by the machine of M. Collas, but professes ignorance as to the means by which it was accomplished. The picture represents a medal about two inches and a half diameter. It has obviously been produced by a machine similar to the one described in the text.

small affair, only occupying a space of about ten inches by five, the object to be copied, which may be a medal, a seal, a plaster cast, or something of a like nature, is clamped down on a little frame. A tracing point is mounted on an arm which slides on a bar above so that it is capable of moving to and fro over the face of the object. As it passes over the surface of the object, it is lifted by any projecting parts of that surface. The motion it thus receives is transmitted to a pencil or a tracer (generally with a diamond point) mounted in similar fashion at the other end of the machine, but in the transmission it is changed, by a very ingenious system of levers, from a motion in a vertical plane, or up and down, to a motion in a horizontal plane, or backwards and forwards.

The result of this is, that the relief of the object is represented by a curved line, drawn by the tracer upon the surface fixed below it. This surface might be a plate of metal covered with an etching ground, and it is probably not incorrect to assume that

this was the plan used by the inventor, as in such machines it is not found practicable to incise the lines direct on the metal. When one line has been drawn, the object and the surface on which the copy is being taken are both shifted forward a minute distance, by the turn of a screw, and another line is drawn. The first tracer thus gradually travels over the face of the object, and a series of lines is drawn by the second tracer, which, in their entirety, represent the whole surface of the article to be copied. It is evident that the apparatus can only be used for objects, not only in very low relief, but of which the relief is very gradual, since the tracer must have a gentle slope to travel up; if it comes to any sudden rise, its progress is checked.

An excellent example of the work which can be effected by machines of this class is the little vignette on the title-page of Babbage's "Economy of Manufactures,"[1] which was made by Bate's machine. They

[1] Published in 1832.

will produce satisfactory work without calling for much skill in using them, but their applications are limited, and the purposes for which they were intended can now be more readily attained by other means.

In some recent engravers' ruling machines a similar device has been added, so that the machine can be used for copying medals, seals, etc. The chief employment of such machines is for preparing plates for printing cheques, bank notes, and similar subjects. The ruling machine, in its simplest form, consists of a frame some three feet or so in length, along which a carriage slides, carrying a tracer. This tracer has a diamond point, though it is only used for drawing lines on an etching ground, which can be afterwards etched. The plate on which the lines are to be ruled is secured on a table below the frame. By means of a screw, the tracer can be shifted in a direction at right angles to that of its travel, in order to form the interspaces between the lines, and according as the tracer is shifted a smaller or a greater distance, so are the

lines nearer together or wider apart. In ruling the lines to form a tint, it is of course necessary that they should come sharp up to the edges of any objects represented in the picture, thus, in a sky, the lines must run up to the edges of trees, roofs, or other objects shown as standing out against the sky. In practice this is generally managed, not by carefully ruling the lines exactly to the required point, as this would necessitate very slow working, but by ruling them so that they slightly overlap the edges, go a little beyond, that is, where they ought to stop, and then, before the etching, carefully going over the outline with stopping-out varnish, so that the ends of the lines, where they exceed the proper length, are practically obliterated. The workman can thus go on rapidly with his work, without stopping to see that it is accurately finished in the first instance.

When it is desired to rule a waved line, instead of a straight one, a more complicated machine is required. In this case the tracer has an oscillating motion imparted to it,

and it is thus caused to draw a wavy line as it travels along. The precise form of the wave is controlled by a little wheel, the rim of which is fluted in accordance with the shape it is desired to give to the wave. An arm resting on the rim is moved up and down, and by a system of levers this motion is transmitted to the tracer, so as, as in Saxton's machine, to give it an oscillating motion in a horizontal plane. By a little further modification, the tracer can be caused to follow the outline of any object in relief, and thus to produce a copy of it on a flat surface.

The machine used by wood-engravers is similar in principle, but very different in construction, since it has to plough out the line in the wood, instead of merely tracing it on the prepared surface of the metal. It is therefore much heavier and stronger, and the tool is driven forward by a wheel, instead of being merely run along by hand. In using it the workman has to stop his lines at the points where they are to end, or else to complete his work by hand.

Of the devices for producing pictures simply by the use of mechanism, the engraving machine of Mr. Shanks may certainly claim to be the most ingenious and the best. For some purposes to which it was applied on its first introduction, it has been superseded by the etching processes, but there yet remain various and important uses for it.

It is in principle an application of the eidograph, the well-known device by which drawings can be reduced or enlarged. In the eidograph a tracing point is mounted at one end of a system of levers, at the other end of which is a pencil; when the tracing point is moved over the lines of the drawing to be copied, the pencil draws a facsimile, larger or smaller, according as the fulcrum on which the system of levers turns is nearer the original or the copy. In Mr. Shanks' machine the plate to be drawn upon is moved under the drawing implement, which is a rapidly revolving cutter, instead of the implement being moved over the plate, and the plate, or rather the carrier which holds it, is therefore mounted on the

end of the system of levers. The carrier is mounted in the same way as the slide rest of a lathe, so as to have motion in two directions, one at right angles to the other, and consequently by a combination of the two, of motion in any direction in the same plane. If, now, a plate of a suitable substance, such as hardened plaster of paris, be mounted on the carrier, and the tracing point at the other end of the lever moved over the lines of a drawing, the cutter will be caused to plough a little furrow which will follow the lines of the drawing. When the process is finished, the lines of the drawing will be represented by furrows of uniform depth (since the point of the cutter is always at the same spot, and the plate has been moved about under it in a horizontal plane), the outlines of which are, if the operator has done his work accurately, identical with the outlines of the drawing. Means are provided for raising the cutter out of action to enable it to pass over spaces which are to be left blank. When a broader line is required, it can be

obtained by setting the cutter a little "out of truth," so that, instead of rotating on its own axis, it describes a very small circle, or by using a cutter, the point of which is not quite in the centre, when the same effect will be produced.

When the plate is finished, a stereotype is taken from it, and that forms the printing surface required; or, if the type with which the block is to be printed is stereotyped, a cast is taken in fusible metal, and from this a stereotype is produced by the ordinary paper process. The cutter is formed with a pyramidical point, and consequently the grooves it forms are V-shaped. In the stereotype, therefore, the section of the lines is an inverted V. These lines, stand-on a broad base of metal, are in consequence very strong, and well suited for rough printing. They will even stand the very severe test of being printed on a cylinder machine, such as is now-a-days used for all daily newspaper printing.

From the description it will be seen that the machine is not intended for fine or

delicate work; its chief application has hitherto been for newspaper work, such as the weather diagrams, sketch maps, and outline sketches, published by most, if not all the daily papers. There is, however, one class of illustration for which it is specially suitable. When the same outline has to be repeated several times, with slightly differing details, as, to take a familiar instance, with the weather charts in the *Times* newspaper, a block with the recurring outlines is first made, and plates moulded from this; the details alone then require to be separately cut upon these plates. Statistical or other diagrams, with curves plotted out upon them, may thus be readily and rapidly prepared, and in cases where a number of such similar, but not identical, diagrams are required for purposes of comparison, this process affords, to the best of the writer's knowledge, by far the cheapest method of providing them.

Work of a certain amount of elaboration has been done on the machine, but for most purposes it cannot compete with the etching

methods. Its principal advantage is in the great speed with which it can turn out clear and simple diagrams for newspaper work. The clean-cut lines produced by the machine are excellently suited for stereotyping, but so far as the illustration of books is concerned, there does not seem any probability of its use extending beyond the applications named above.

A very simple method of preparing plates which can be printed in the same manner as copper plates, and give results precisely similar to an ordinary etching, has been devised by Mr. G. Dawson. A thin plate of vulcanite is covered with a white ground, in order to enable the artist to see what he is doing. A sketch is made on this with an etching needle, sufficient pressure being used to scratch the surface of the vulcanite. Very little pressure is required, and it is found the needle readily makes a nice clean cut in the vulcanite quite deep enough to hold the ink. The white ground is then removed, and the plate is ready without further preparation for printing.

This appears to be the simplest method known of producing a printing surface, and it ought to prove a very convenient plan for etchers who are in the habit of drawing direct from nature. There seems no reason why the plates should not stand a reasonable amount of work, and the results they give are quite satisfactory.

Similar effects may also be attained by employing a sheet of gelatine for drawing upon. The gelatine has the advantage of not yielding to pressure. Vulcanite might be expected to stretch and flatten out under pressure, but this gelatine does not do. On the other hand, the gelatine is not so easy to work upon, and does not give such a good line. Both methods may be recommended to those who can etch.

A very simple and satisfactory device for reproducing drawings will be found to be the employment of a glass plate covered with an opaque film, on which the drawing can be made with a needle point. The glass may then be treated precisely as if it were a photographic negative, and

positives printed from it, by the ordinary photographic printing processes; or if a printing surface be required, it may be produced by any of the methods described in the preceding pages. The only difficulty is to obtain a film which is thoroughly opaque to light, and will give sharp lines without chipping. The best film for the purpose is one devised by Sir John Scott, and described in Holtzapffel's book on Turning, and elsewhere;[1] but sufficiently good results can generally be obtained by mixing some suitable colouring matter with an old sample of collodion, and adding also a few drops of water, sufficient to give a crapey appearance to the film.

[1] There is an error in the formula as given by Holtzapffel, 60 drachms being substituted for 6. The following is correct, and will be found to give excellent results :—

Negative collodion, ½oz.;
Alcohol and Ether, each 6 drachms;
Shellac, 30 grains;
Aurine, 2 grains;
Judson's ruby dye, 30 drops;
Water, 30 drops.

—*Holtzapffel*, Turning, etc., vol. v. p. 287. It should be poured on the glass like ordinary collodion, and allowed to dry.

APPENDIX I.

Preparation of Drawings for Reproduction.

The following are the detailed instructions (referred to on p. 72) issued by the Indian Survey Office for the guidance of draughtsmen in the department. They were reprinted in the *Photographic News*, 1882, p. 482.

1.—The drawings should be made on white smooth-surfaced paper, fresh tracing cloth, or, best of all, fine Bristol board. When possible, the drawing should remain stretched on the drawing board, and in any case should be kept as clean as possible, and free from pencil marks, creases, and wrinkles. Little defects, which may scarcely be noticed on the original, frequently attain undue prominence in the photograph.

2.—The best ink to use is Indian ink, which should be freshly and evenly rubbed down, and be sufficiently thick to give a good full black line. A little yellow

pigment, such as gamboge, or preferably burnt sienna, is sometimes added, and Capt. Hannot recommends rubbing down the ink in a very weak solution of bichromate of potash. In adding yellow to the ink, care must be taken to use some substance which will not spread beyond the lines, especially when drawing on tracing cloth.

3.—The lines should be firmly and clearly drawn, not too fine or too close together. Even the finest lines must be quite black. Light effects must be produced by making the lines thinner, and increasing their distance apart, and not by the use of pale ink. In removing pencil marks after the drawing has been inked in, great care must be taken not to destroy the blackness and firmness of the lines by too much rubbing; otherwise they will appear quite rotten and broken when reproduced.

4.—Cross-hatching and shading should be open, and in firm clear lines, not too close together, or confused by fine lines. Intensity of shade should be shown by an increase in the thickness of the lines rather than by their being placed close together. It must be borne in mind that throughout the process there is a tendency for the lines to thicken, so that if they are too close they are liable to block up in the printing, and the work will appear heavy and unsightly. This rule also applies while shading, the darker portions of which should be drawn in thick distinct lines, but not crossed and recrossed with fine lines.

5.—In drawing maps it is better to leave river courses, coast lines, lakes, ponds, or tanks, blank, and not filled in with fine lines. They may be indicated on the original by a pale wash of blue, without detriment to their reproduction.

6.—Similarly in mechanical or architectural drawings, ruled tints and shades are better left blank on the original, or shown by light tints of blue, violet, or aniline red. Engraved tints in lines or dots can be transferred on the stone afterwards, and will have a much neater effect than tint lines reproduced directly from the original.

7.—Washes of any colour, except pale blue, violet, aniline red, or other colours which will not reproduce, are absolutely inadmissible in drawing for reproduction by photolithography. If necessary, outlines may be drawn in some pigment which will reproduce black, such as strong red, brown, yellow, orange, or green. Details required to be shown in the original, but not in the copy, may be drawn in pale blue, aniline, violet, or red. Spots, stains, and details not required to be reproduced, can be painted out with Chinese white.

8.—Whenever possible, the original drawings should be on a larger scale than the reproduced copy. Defects in drawing are lessened by reduction, and the result generally is finer and sharper than a reproduction to scale would be.

9.—In preparing drawings for reduction, care must be taken that the lines, lettering, and detail are drawn of sufficient thickness and size relatively to the scale of reduction, so that they may be clear and distinct, and in proper proportion together when reduced, and not be so small as to be either quite lost or illegible. Thus, if it be required to reduce a drawing to one-fifth the scale of the original, every line must be drawn five times as thick, and the writing and details five times as large as required in the reduced copy. Sufficient space must also be left between lines of shading or cross-hatching to prevent their blocking

up and running together in transferring and printing. Practically, it is sufficient to draw the original from about one and a half to twice as large as the copy to secure all the advantages of reduction, and the originals will also serve for reproduction if necessary.

10.—It will save confusion and mistakes if the scale on drawings intended for reduction is shown in terms of a single unit of measurement, as inches, feet, miles, etc., and not as relative to any second unit, as inches to a foot, mile, etc. It should be shown simply as scale of feet, miles, etc.

11.—Drawings or tracings intended for reproduction should not be folded, but kept flat or rolled. Folding causes creases, which give shadows on the negative in reproduction, and these may obscure and spoil other details. It is a good plan to pass a creased drawing through a copper-plate or lithographic press before copying.

12.—It must be borne in mind throughout that photography will only produce a *facsimile*, and that, as a rule, the original will not be in any way improved upon. Rough, coarsely-drawn work will not appear like fine engraving, or bad writing like letter-press or copper-plate, and therefore in making drawings for publication, care must be taken to give them the requisite degree of neatness and finish before they are copied, so that the result may be fit for immediate issue, and not require alteration and touching up, which causes delay and expense, besides deteriorating the work before it is printed.

APPENDIX II.

Books of Reference.

The following list of books dealing with subjects to which allusion has been made in the preceding pages may be useful.

The only other English sources of information on Photo-mechanical printing processes are, to the best of the writer's knowledge, the pages of the two Photographic newspapers, the *Photographic News* and the *British Journal of Photography*.

Special reference should be made to the series of articles on Photo-lithography by Lieut.-Colonel Waterhouse in the volumes of the *Photographic News* for 1882–3–4–5, and to the series on Photolithography and Photo-mechanical Printing by T. Bolas in the *Journal* during 1878 and 1879.

There are several text-books in French and German. Léon Vidal has written some in the former language; J. Husnik, J. Allgeyer, L. Berndt, L. Mosk, J. Schnauss in the latter.

History of Wood-engraving. By J. Jackson and W. Chatto. 2nd edition, 1861.

Besides a history of the art, the authors give an account of the methods, tools, etc., employed.

Etchers and Etching. By P. G. Hamerton. 2nd edition, 1876.

In an Appendix Mr. Hamerton gives full instructions for the process of plate-etching, and describes the tools, chemicals, presses, etc., required. "The Etcher's Handbook," by the same author, supplies similar information.

Grammar of Lithography. By W. D. Richmond. 1878.

Intended as a guide to the practical lithographer. Full practical details are given, and information of every sort likely to be useful in the workshop. A most valuable book for its purpose.

The Art of Chromolithography. By G. A. Audsley. 1883.

This contains a magnificent series of plates, showing the design on each stone, and the effect of each successive printing. The example selected is a most remarkable reproduction of a piece of Japanese lacquer-work, requiring twenty-one printings. The text gives a brief but sufficient account of the process.

Treatise on Photography. By Capt. W. de W. Abney. 1878.

Instruction in Photography. By Capt. W. de W. Abney. Seventh edition, 1886.

The photographic processes referred to in Chapter II. and elsewhere will be found fully described in

Captain Abney's well-known treatises. The first-named book (one of Longman's "Text-books of Science") is intended for the general reader; working instructions are given in the second.

The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment. By T. Bolas. 1878.

Recent Improvements in Photo-mechanical Printing Methods. By T. Bolas. 1884.

Two series of Cantor Lectures delivered before the Society of Arts and published in the Society's Journal, vol. xxvi. and vol. xxxii.; also as separate pamphlets. They form the best treatise on the subject in the language, in fact the only one in which a trustworthy account of the different processes is given. Unfortunately they are very brief.

Guide to Art Illustration. By J. S. Hodson. 1884.

Gives a useful series of examples of some of the principal methods.

Zincography. By Josef Böck. Translated by E. Menken. n.d. (published 1886).

A brief but clear description of the method of making etched blocks. Working details are given.

Photo-engraving . . . and Photolithography. By W. T. Wilkinson. 1886.

This book is announced for publication, but has not yet appeared.

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